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EVALUATION OF THE PROPOSED AMBIENT AIR MONITORING EQUIVALENT AND REFERENCE METHODS

J. J. Wesolowski, et al

California State Department of Health

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The report assesses the adequacy of the Environmental Protection Agency's proposed Ambient Air Monitoring Equivalent and Reference Methods, published in the Federal Register of October 12, 1973. To assess the applicability, validity and workability of the regulations and determine the costs to demonstrate equivalency, the provisions, specifications and test procedures of the regulations were evaluated in two phases using three automated methods or analyzers and two manual methods. The comments regarding the proposed regulations submitted to EPA by respondents were also reviewed.
The cost and man-hours required to perform each of the test procedures was also estimated.

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1.0 INTRODUCTION

When the federal Environmental Protection Agency (EPA) promulgated the national primary and secondary ambient air quality standards on April 30, 1971 (40 CFR 50) for six pollutants, the promulgation was accompanied by prescribed "reference methods" for the measurement of the pollutants. To avoid obsolescence of existing analytical instruments and to encourage development of superior methods, EPA also designated that the pollutants may be measured by "equivalent methods". An "equivalent method" was defined as "any method of sampling and analyzing for an air pollutant which can be demonstrated to the Administrator's satisfaction to have consistent relationship to the reference method". This definition was later amended in 40 CFR 51 (Aug. 14, 1971) to require that an equivalent method must "demonstrate a consistent relationship and/or meet performance specification with the reference method". This change, therefore, allows three mechanisms by which an analytical method can be established to be equivalent to a reference method: (1) meet performance specifications, (2) demonstrate consistent relationship, or (3) meet both (1) and (2).

To provide a standardized set of test procedures by which any ambient air analytical method can be established as an equivalent method, EPA developed the "Ambient Air Monitoring Equivalent and Reference Methods" referred to in this report as "equivalency regulations" or simply "regulations". The first draft of the regulations was completed by EPA in February 1972 and reviewed internally. A revised draft was then submitted in May 1972 to members of the Scientific Apparatus Manufacturers Association, EPA Regional Offices, selected state air pollution agencies including the Air and Industrial Hygiene Laboratory (AIHL) and other scientists within EPA for review and comment. A final draft of the regulations incorporating the relevant comments was completed by EPA with the assistance of AIHL staff in April 1973 and proposed in the October 12, 1973 issue of the Federal Register (40 CFR 53)[1].

The proposed regulations consist of a preamble and three subparts. The preamble describes the legal basis, purpose and application of the regulations. Subpart A (General Provisions) describes the general requirements that must be met, the information and affidavits that must be supplied and the appeal procedures to be followed. Subpart B (Test Procedures for Measuring Performance Characteristics) lists the performance specifications that automated reference and candidate methods must meet and describes the test procedures to be followed. Subpart C (Test Procedures for Demonstrating Consistent Relationship Between Reference Methods and Candidate Methods) contains the test procedures, specifications and sampling plans to be used. It is the intent of EPA to apply these regulations to both manual and automated ambient air monitoring methods for oxidants (Ox), sulfur dioxide (SO_2) and carbon monoxide (CO).

To assess the adequacy of the proposed regulations, the Air and Industrial Hygiene Laboratory of the California Department of Health under contract with EPA evaluated the April 1973 version of the proposed regulations.

This report describes the (1) purpose of the contract, (2) procedures used to evaluate the regulations, (3) results obtained, (4) deficiences uncovered and the changes recommended to improve or correct them, and (5) approximate cost and man-hours required to conduct the various test procedures and to establish equivalency of an analytical method. In addition, this report also contains a copy of the proposed regulations (Appendix I), AIHL's recommended drafts of Subparts B and C (Appendix II and III, respectively) and AIHL's review (Appendix IV) of the respondents' comments on the proposed regulations.

2.0 PURPOSE AND SCOPE OF CONTRACT

The purpose of the contract is to: 1) evaluate the test procedures, specifications and sampling plans described in EPA's proposed "Ambient Air Monitoring Equivalent and Reference Methods" using three automated methods, 2) maintain records of the test results of the evaluation, 3) delineate any problem areas in the test procedures and make recommendations for their correction and/or clarification, 4) determine the approximate cost and total man-hours required to perform each of the test procedures and to establish equivalency, 5) provide an estimate of man-hours necessary to review the test data for certification or rejection of a candidate method tested in accordance with the regulations.

In addition, comments submitted to EPA by interested parties regarding the proposed regulations were reviewed.

3.0 TEST FACILITY AND EQUIPMENT

3.1 TEST CHAMBER

The regulations specify that the temperature of the gas generation system shall be maintained within ±2°C to assure stable output [153.3(g), Table B-4]. To satisfy this requirement, the gas generation system shown in Fig. 1 was installed in a 13 X 7 X 8 feet temperature and humidity-controlled test chamber[2]. The temperature in the chamber can be maintained within ±0.5°C from 0 to 45°C and the relative humidity to within ±5% from 5 to 85%. An air-conditioned room capable of meeting the test facility requirement may be used as well. All the tests for measuring performance characteristics were conducted in the chamber.

3.2 GAS GENERATION SYSTEM

The system used to generate the test atmospheres needed for the evaluations is shown schematically in Fig. 1. The test atmospheres were generated according to the procedures specified in Table B-2 and ¶53.21 (a) of the regulations. The system consisted of the pollutant generators and four test atmosphere ducts or lines. Test Atmosphere Z (zero air), P (pollutant gas) and I (interferent gas) were generated through the first, second and third lines. The atmosphere PP (pollutant gas of different concentration from P) was generated through the fourth line.

To insure stable test atmosphere concentrations, borosilicate glass tubing (3/8 inch I.D.) was used to construct the test lines where necessary. Copper tubing and brass fittings were used in other areas. Flowmeters[3] were used to measure the flow of the test atmospheres. In addition, a mass flowmeter[4] coupled with a strip-chart recorder, was installed in the pollutant test line (P) to monitor the pollutant gas flow at all times. The recorder trace provided a continuous record of the pollutant flowrate which was particularly useful during periods of unattended tests. Downstream of the flowmeters, the test lines were fitted with three-way valves so that the gas flow in one line could be combined with the other as required. Kjeldahl-type connecting bulbs installed immediately after the valves were used as mixing chambers for the gas streams.

Cylinder zero air[5] was used to dilute the test gases as specified in the regulations. At a nominal flow of 2 liters per minute, the volume of zero air contained in a size 1A cylinder (about 220 cu. ft.) was sufficient to provide about 48 hours of continuous operation per test line or only 12 hours when all four lines were in use. To permit sustained operation, the cylinders were manifolded as shown in Fig. 1 so that when one cylinder was exhausted another could be switched on without interrupting the gas flow in any of the test lines while the empty cylinder was replaced with a full one. To conserve cylinder zero air, the test lines were also connected to a source of filtered ambient air during idle test periods. The gas generation system was designed such that the changeover from one air source to the other could be accomplished conveniently and rapidly by turning a valve on each test line.

The test concentrations were verified using the reference methods given in Table B-2 and in accordance with the test directions in Subpart B.

3.3 SAMPLING PROBE AND MANIFOLD

The test procedures for demonstrating consistent relationship [¶53.30(b)] provide specific requirements for the collection and transport of the ambient air test samples. An ambient air sampling system which met the requirements was designed and installed at the California State Department of Health's laboratory facility at 2002 Acton Street in Berkeley. The sampling probe was constructed from borosilicate glass pipes[6], 1.5 inches I.D. by 5 feet long segments, joined together by Teflon sleeves supported by snap-on plastic shells. The probe consisted of a vertical section that extended by about 17 feet above the roof of a one-story building and a horizontal section which was suspended parallel to the ceiling of the test room. A single 90° connector was used to join the vertical and horizontal sections. The single bend minimized loses of airborne particles in the ambient air samples. A specially designed glass sampling manifold (Fig. 2) with 4 radial sampling ports (1/4 inch I.D.) to provide essentially identical samples to the methods under test was connected at the end of the horizontal section of the probe. About 10 feet upstream of the sampling ports, a spiking port of 1/4 inch I.D. glass was installed at the lower end of the vertical section of the probe for introducing zero air (for diluting) or pollutant for spiking (enriching with pollutant) the ambient air stream. Ambient air was drawn continuously through the probe and manifold by a centrifugal fan at about 1 CFM. The air flow was monitored by a mass flowmeter. The inlet of the sampling probe was fitted with a sheet metal low conical hat to exclude rain, and with 100 mesh stainless steel screen to prevent debris and insects from getting drawn into the air sampling system.

The concentrations of the pollutant of interest in the air samples were adjusted to the desired levels by diluting the air stream with zero air or spiking with pollutant from a generator. The pollutant generators used were fabricated according to the systems designated in Table B-2 of the regulations. The spiking rates were adjusted such that at least 60% of the test atmosphere consisted of ambient air at all times.

3.4 AUTOMATED METHODS OR ANALYZERS

The contract required that the regulations be evaluated using three automated methods. The analyzers used were the Technicon Air Monitor IV[7] for sulfur dioxide, Melpar total sulfur analyzer[8] and Bendix ozone monitor[9] and were furnished by the Quality Assurance and Monitoring Laboratory of EPA. The identity, detection principles and some performance characteristics of the three analyzers as given by the manufacturers are given in Table I.

The Technicon analyzer represented one of the older types of instruments which uses the wet-chemical colorimetric measurement principle, generally characterized by slower response (t_1= 5 to 30 min.) and by sensitivity to large number of interferents. The Melpar and the Bendix units represented the later monitors which are technologically more advanced, generally fast-responding (t_1 = 1 sec to 3 min.), utilize detection systems that directly measure some physical properties of the pollutants of interest and in general insensitive to interferents.

All three analyzers were used units and all required extensive maintenance and repair before they could be used in the evaluation. Some of the problems encountered with the analyzers are discussed in Section 5.3 of this report. Additionally, they were not necessarily the latest models in their respective categories.

4.0 EVALUATION PROCEDURE

4.1 EVALUATION OF THE REGULATIONS

Subparts A, B and C of the April 1973 version of the proposed regulations were first inspected for obvious errors such as misprints, inconsistent directions and statements and inadvertent omissions. These deficiencies were first resolved with the project officer before the actual testing was initiated.

Subpart A did not contain any procedures that required testing. Subparts B and C were evaluated in two phases. In Phase I, the test procedures in Subpart B were tested using the Technicon and Melpar analyzers for SO_2. Deficiencies discovered during the testing were corrected and the corrected test procedures were retested in Phase II using the Bendix monitor for O_3 to validate the changes made and to further identify any deficiencies not discovered in Phase I.

Subpart C consists of three separate but essentially identical test procedures for demonstrating consistent relationship for oxidant, sulfur dioxide and carbon monoxide methods. The initial evaluation (Phase I) of Subpart C was conducted with oxidant methods using the Bendix ozone monitor against the manual potassium iodide (KI) method[10]. Based on the results of this test, Subpart C was redrafted into a combined test procedure applicable for all three (oxidant, sulfur dioxide and carbon monoxide) methods. The validity of the combined test procedure for Subpart C was then verified in Phase II using the Technicon and Melpar analyzers as candidate methods against the manual p-rosaniline as the reference method.

During the testing process, a record of the approximate costs and man-hours required to conduct each of the test procedures was maintained to obtain an estimate of the total cost and man-hours required to demonstrate equivalency.

4.2 REVIEW OF RESPONDENTS' COMMENTS

The regulations as proposed by EPA in the Federal Register on October 12, 1973 (40 CFR 53) included an invitation for comments from interested parties. This resulted in the receipt of 29 communications by EPA; 16 from governmental agencies, 10 from industry representatives and 3 from private individuals.

Although not specified in the original contract, at the request of the project officer, these communications were reviewed by AIHL. The review was initiated by randomly assigning each respondent's communication a code number from 1 to 29 for convenience in referencing. The communications were then individually reviewed for the comments pertinent to the proposed regulations. In most cases the comments were paraphrased, when possible, into one or two sentences or into a simple paragraph, and then categorized by subject matter, tabulated and indentified with the part, paragraph, section or item in the regulations. The categorized comments were reviewed and recommendations were prepared based on AIHL's expertise and familiarity with the regulations.

5.0 RESULTS AND DISCUSSION

As discussed earlier, the proposed regulations stipulates that the equivalency of a candidate method may be determined by one of three mechanisms: (1) meeting the performance specifications (Subpart B), (2) demonstrating consistent relationship (Subpart C) or (3) meeting both (1) and (2). Subpart B, further, specifies that the tests for each performance parameter is to be conducted seven times. When all seven test results for each parameter meet the specification given in the regulations, the automated method or instrument is passed for that parameter. When the instrument fails three or more of the seven trials, the instrument is rejected for that parameter. When one or two of the test results do not meet the specification, then a second series of eight tests for that parameter is to be conducted and the same pass-fail criterion is applied to the combined total of 15 test results. Except for the number of repeat determinations, similar criterion for the interpretation of Subpart C data for consistent relationship is followed.

In Subpart B however, while the procedures for zero and span drifts, lag time, rise time, fall time and precision [53.22(f)] stipulate that the test for each parameter is to be conducted once a day over seven days, the number of trials to be performed is not stated in the remaining procedures for noise, lower detectable limit (LDL) and interference equivalent (IE). In the evaluation process, therefore, this omission was interpreted to mean that the general provisions applied to those procedures in which the number of trials were specified and only one trial was conducted for the other procedures (noise, LDL and IE). The values reported for these procedures in Tables V and VIII are based on the results of the single trials. The deviation might affect the instrumental results obtained, but we do not believe it compromised the overall objective of evaluating the procedures for these three parameters.

5.1 PRELIMINARY REVIEW

The initial inspection of Subparts A, B and C of the April 1973 draft of the regulations uncovered a large number of typographical errors, omissions, unclear directions and inconsistent statements. These findings gave rise to several questions regarding the intent and application of the procedures. Table II lists the questions that pertain to Subpart B as well as the suggestions for correcting them. Table III delineates the deficiences found in Subpart C and the recommended changes. In response to some of the foregoing questions, suggestions and recommendations, several changes were authorized or requested by the project officer. These are also noted and discussed in Table IV.

5.2 EVALUATION OF SUBPART B

The analyzer performance data obtained in the course of evaluating Subpart B are shown in Tables V and VI along with the summary of conclusions drawn and the changes recommended. The bases for the recommendations are discussed below:

5.2.1 General Provisions

a. ¶53.20(a): The first sentence can be misinterpreted to mean that the automated methods are for developing observations on Interference---etc. rather than the test procedures. For clarity it should read "Test procedures applicable to automated candidate and reference methods for observations on Interference---etc."

b. The general provisions also do not state when the method satisfies the requirements of Subpart B of the regulations. We therefore recommend that the following statement be added after the first sentence, "The methods must pass all the specifications for performance to satisfy the requirements of the subpart". Moreover, the provisions do not indicate the ambient conditions at which the tests are to be conducted. We recommend that "and at normal ambient temperature of 20 to 30°C and normal line voltage of 110-125 VAC" be added after the word "section" in the second sentence.

c. ¶53.20(c): This paragraph states that an initial series of seven tests is to be performed on all the performance specifications. In the individual procedures, however, this requirement is stated only in the procedure for drifts, response times and precision [53.22(f)(1)] and further emphasized in Table B-4 [53.22(g)]. Unless it is the intent of EPA to require all tests to be repeated seven times, we recommend that the second sentence be revised as follows: "For each performance specification for range, noise, lower detectable limit and interference equivalent, perform the tests as directed in the test procedures. The method or instrument must pass all the above specifications before other tests are begun. For each performance specification for drifts, response times and precision, an initial series of seven (7) tests shall be conducted".

d. ¶53.20(d): Table B-1:

1. Only one specification is listed for noise while the test procedure (¶53.22(b)(2)) requires the test be conducted at both 0 and at 80% of the upper range limit. The missing specification should be provided and included in the table.

2. The total interference equivalent is calculated as the sum of the absolute values of the individual interference equivalents. Therefore, the minus signs before the specification for total interference equivalents do not apply and should be deleted.

3. Only one specification is listed for span drift. The span drift tests, however, are conducted both at 20 and 80% of the upper range limit [¶53.22(f)(4)]. The missing value should be supplied and included in the table.

4. Superscript "(d)" after "12-hour" for zero drift should be changed to "(c)" to be consistent with the footnote.

5.2.2 Gas Generation

a. The design of the gas generation system inferred from ¶53.21(a), Table B-2 and ¶53.22(d) in the regulations provides for one pollutant line. This permits only one pollutant concentration to be generated at a time. Most of the test procedures, however, constantly require two concentrations (usually at 20 and 80% of full scale). This requires repeated resetting of the diluent air flow to obtain the concentrations needed. This process is time-consuming and makes production of consistent concentrations impossible. To provide a constant supply of each test gas concentration, we recommend that a second pollutant test line be specified (See 3.2 of this report). The generation system will then require 4 instead of the present 3 test lines; one for zero air (Z), one for the interferents (I) and two for the pollutant of interest (P and PP). This change will assure constant test gas concentrations and increase reliability as well as efficiency.

b. ¶53.21(a): This section specifies that the "temperature of the gas generation system shall be maintained within ±2°C to assure stable output" and that the "test gas concentration shall be consistent from day to day [(f)(4)(vi)]". The test procedures for zero and span drifts (Table B-4), however, are conducted both at 20 and 30°C. This implies that two temperature-controlled test rooms or chambers, one for the instruments under test and one for the gas generation system, are required. This question should be clarified. Also, when a change in the gas concentration does occur, how much can be tolerated? Can correction factors be used?

c. ¶53.21(b): The concentrations specified in Table B-2 of the regulations for the stock cylinders of carbon dioxide, carbon monoxide, methane and xylene correspond to the interferent test concentrations listed in Table B-3. Some tests, however, require mixing the interferent with the pollutant gas which would reduce the concentration. Therefore, the concentrations should be increased by at least a factor of 2 to allow for the dilution [¶53.22(d)(2)(iv)(c)] of the gases for the interference tests.

d. The reference procedure stipulated in Table B-2 for verifying the concentration of ammonia is inadequate as the excess acid in the absorbing solution must first be neutralized before reacting the collected ammonia with the phenate reagent. Instructions for neutralization with 0.1 N NaOH solution should be added or better yet, the procedure should be changed to the Intersociety Committee Method, "Tentative Method of Analysis for Ammonia in the Atmosphere (Indophenol Method), ISC Method 42604-01-72T, Health Laboratory Science, Vol 10, No. 2 (April 1973).

5.2.3 Calibration

a. ¶53.21(c)(2): The procedure states that the analyzer baseline be offset by adjusting the recorder controls.

However, some analyzers do not indicate below zero output response with less than zero input when their controls are set at zero. In these instances, offsetting the recorder by 5% without adjusting the analyzer zero output to an upscale value would be meaningless. We recommend that the procedure be modified so that the adjustment to obtain 5% offset zero reading on the chart be made, when possible, with the analyzer controls rather than with the recorder's. Therefore, the third sentence of the paragraph should be rewritten as follows, "adjust the instrument controls, when possible, to obtain a 5% offset zero reading on the recorder chart."

b. The output signals of all analyzers are not always in volts or millivolts, but may also be described in some other units. Therefore, revise the last sentence of the paragraph to read "....volts, millivolts, milliamps or other appropriate units".

c. The procedure stipulates that the calibration curve is to consist of a graphical plot of pollutant concentrations versus analyzer response. The procedure [53.22(b) - (f)] subsequently specifies that the analyzer readings are to be converted to concentrations by reference to the curve. This use of the curve, however, is subject to bias and may yield inconsistent or erroneous data. To minimize such inconsistencies, we recommend that the pollutant concentrations be determined by dividing analyzer readings by the slope of the calibration curve and that such slope be obtained by the method of least-squares.

Figure 3 shows the Technicon analyzer response to SO_2 when treated by the least square, best-fit technique. A straight line with a slope of 118.7 and a y-intercept at 1.68 was obtained. The greater than 100 slope indicated that the analyzer's response to SO_2 gas was greater than the response predicted by standard calibrating solutions. While the cause of this discrepancy could not be resolved, this did not affect the performance of the analyzer and the calibration was corrected to a slope of 100 by spanning the instrument to read the span SO_2 gas concentration.

However, a plot of the Melpar analyzer readings versus concentrations yielded, on linear coordinate paper, a convex curve which appeared logarithmic (Figure 5). The readings and concentrations were then converted to their respective logarithms. The least-square line then yielded a straight line with a slope of 0.322 and a y-intercept of 1.97 as shown in Figure 4.

These results confirm that the best-fit technique can be applied to both linear and logarithmic response and indicate that the mathematical conversion of the instrument outputs to pollutant concentrations by reference to the slope of the curve will yield more consistent results.

5.2.4 Noise

This procedure calls for determinations at 0 and 80% of full scale by taking 25 random readings with a digital meter (DM) over 1-hour periods. The permissible tolerances are given in Table B-1 [53.20(d)] of the regulations. The evaluation revealed the following changes were needed:

a. ¶53.22(b)(1) line 8: Put period after "units" and add "The specifications are" before "given".

b. ¶53.22(b)(2)(ii): The recorder is not required in this test. Delete the entire procedural step and renumber (iii) to (viii) to (ii) to (vii).

c. ¶53.22(b)(2)(iii): No chart tracings can be submitted since a DM is used instead of a recorder for the test as directed in step (ii). Delete the second sentence.

d. ¶53.22(b)(2)(vii): The procedure calls for determining the mean ($\bar{k}$), deviations (di) and standard deviation (s) directly on the digital meter (DM) readings obtained. While this method is valid for linear response where the deviations are proportional to the DM readings, it cannot, however, be applied where the deviations are not proportional to DM readings, as in the log-linear response of some instruments (e.g. Melpar).

We recommend instead that the individual DM readings be converted first to concentration units before determining noise. To accomplish this, steps (vi) to (viii) should be revised to read [Refer to ¶53.22(b)(2)(ii in 5.2.4(b) above for recommendation in numbering of steps]as follows:

"(v) Convert the individual DM readings k_1, k_2-----k_{25} to concentration units c_1, c_2---c_{25} by reference to the previously determined calibration curve of the analyzer, and determine the mean by:

$$\bar{c} = \frac{\sum c_i}{25}$$

Deviations about the mean are determined by

$$d_i = c_i - \bar{c}$$

and the standard deviation or noise is,

$$s = \sqrt{\frac{\sum (d_i)^2}{24}}$$

Report the noise at 0% of the upper range limit in ppm.

(vi) Repeat steps (iv) through (v) using a pollutant test gas concentration producing an output of 80 ± 5% of the specified upper range limit and report the noise."

5.2.5 Lower Detectable Limit

a. ¶53.22(c)(2)(ii): The test procedure requires that the test gas concentration equal to the specified lower detectable limit value be generated [Table B-1, ¶53.20(d)] and verified [¶53.21(a)]. Our experiences indicate that generation of such low concentrations (0.01 ppm) accurately is difficult and, moreover, that the sensitivity of most reference methods is insufficient at such low levels (i.e., 0.02 ppm). To alleviate this problem, we recommend that the test procedure be modified to read after procedural step (i):

> "(ii) Generate a test atmosphere equal to 20* ± 5% of the upper range limit. Verify the concentration with the reference procedure. Calculate and increase the diluent air flow rate accordingly to obtain the concentration specified for lower detectable limit in Table B-1. Sample the gas stream. Record the stable reading.
>
> (iii) Convert the reading to concentration unit. Pass the instrument for this specification, if this value is equal to or greater than twice the noise at zero obtained in ¶53.22(b)(2)(vi)."

*Note: The 20% value is suggested since this concentration is also needed for many of the other tests.

5.2.6 Interference Equivalent

Interference Equivalent is determined by challenging the instrument with substances that are known or suspected to cause interference. The procedure involves mixing individual interferents with a specified pollutant concentration and comparing the instrument's output to the output caused by the pollutant alone. Where the interferent is known to react with the pollutant in the gas phase, the response to the interferent is determined in the absence of the pollutant. The responses of the Technicon and Melpar analyzers to the various interferents specified in Table B-3 of the regulations are shown in Table V.

a. ¶53.22(d)(2) line 8: "An interferent" should be changed to "The interference".

b. ¶53.22(d)(2)(iii): The procedure calls for generating three test atmospheres; pollutant, interferent and zero gases arbitrarily labeled X,Y and Z. Except for Z, the other labels do not correspond to the identity of the test gases. Also, in 5.2.2 (a) of this report, we recommend that the design of the gas generation system allow for a second source of pollutant gas to permit concurrent generation of two different pollutant gas concentrations. This will require a new designation for the second gas. To facilitate identification of the various test gases during the testing, we suggest that the two pollutant gases be labeled as P and PP, the interferent gas as I and the Z for zero gas be retained.

c. ¶53.22(d)(2)(iv)(b) and (c): Directions here stipulate that the concentrations of the pollutant and the interferent should be adjusted such that when each is mixed with either zero air or the interferent atmosphere, the specified test concentrations are obtained. No provision for establishing the concentrations are provided. We recommend that the concentrations be first verified by the appropriate reference methods before tests are begun.

d. ¶53.22(d)(2)(ix): Add "equivalent" after the word "interference".

e. ¶53.22(d)(2)(xiv) line 2: Delete "s" in "interferences" and add "equivalents".

f. ¶53.22(e): Our experiences indicate that the 25,000 ppm of water vapor specified in Table B-3 is impractical because of condensation in the test line. We recommend that this concentration be reduced to 18,000 ppm (80% RH) which is readily generated at 30°C without problems.

g. Footnote (a) of Table B-3 specifies that the interferent concentration shall be prepared to ± 20% of the required value and controlled to ± 10%. We believe that this requirement is confusing, too liberal and inconsistent with the ± 5% required for pollutant test concentrations. Furthermore, manufacturers whose instruments are borderline with respect to interferences will be tempted to select interferent levels that will minimize the interference equivalent. We recommend that footnote (a) be revised to read "Concentrations of interferents listed must be prepared and controlled to ± 5% of the stated value".

h. Table B-3 does not provide a test for interference of airborne particulate matter. Recent information suggest that analyzers with spectrometric detectors that measure physical properties of pollutants also respond to aerosols. We recommend that a test procedure and specification for particulate interference be developed.

5.2.7 Test Procedures for Zero Drift, Span Drift, Precision, Rise Time, Fall Time and Lag Time.

a. ¶53.22(f): The general direction [(¶53.22(f)(1)] specifies that the tests for zero drift, span drift, precision, rise time, fall time and lag time are to be performed seven times over a period of at least seven days following the sampling plan given in Table B-4 of the regulations and that each test shall be run only once a day. (See also 5.2.1(c) of this report).

The completion, however, of the required daily tests for these response elements depends on the speed of response of the method (analyzer) under test. Our experiences with the Technicon and Melpar analyzers show that even analyzers with response time characteristics equal to the specifications given in Table B-1 in the regulations would require at least 14 continuous hours under ideal conditions. Since 12 hours of the 24 hours in a day is allotted for sampling zero air for the 12-hour zero drift test, it is evident that all of these tests cannot be completed within the time period allotted. In fact, our calculations indicate that the daily tests specified can be completed only with analyzers that can attain 100% response (t_{100}) in 12 minutes or less.

These results indicate that the requirements in the test plan appear incompatible with the performance specifications in the regulations and are thus inapplicable to many existing instruments. Our recommendations in ¶53.22(f)(6)(ii) to ¶53.22(f)(i)(ii) in Appendix II will help alleviate these problems.

b. Our examination also indicate that some of the details regarding the test directions and the test plan given in Table B-4 are inadequate and give rise to questions such as:

1) Are the test procedures for response times (lag, rise and fall time) and precision conducted daily in addition to the zero and span drifts tests?

2) What specific line voltage and test room temperature are used when making the initial zero and span adjustments?

3) Are the subsequent instrument adjustments at the end of the 3-day periods made at the test conditions in (2) above?

5.2.8 Zero and Span Drift

To reduce the possibility of misinterpretation we recommend the following changes be made in this section:

a. ¶53.22(f)(4)(ii): The actual line voltage and temperature to be used at the beginning of the 7-day test should be definitely stated. Rephrase the second sentence to "Instrument is operated at normal line voltage of 125 VAC and normal temperature of 20°C".

b. ¶53.22(f)(4)(iii): In some instruments, the span control interacts with the zero control. To insure that no shift has occurred in the zero baseline whenever the span control is adjusted, add the following after the last sentence, "Rezero the instrument. Where the zero and span controls are not electrically independent, the adjustments may require repeated trials". Also add after "percent" in the first sentence, "(Span 1)" to conform with the test direction in Table B-4.

c. ¶53.22(f)(4)(iv): Add "(Span 2)" after "percent" to conform with the test direction in Table B-4. Also add after the last sentence, "Start Day 0". This addition will alert the testor when to start time zero. Furthermore the change in designation from Day 1 to Day 0 will be more consistent with the terminology of the 7-day or 15-day test. At the end of 7-day period the results are examined, not on the "8th day" as directed in the test procedures.

d. ¶53.22(f)(4)(vi) to 53.22(f)(4)(xi): For greater clarity, we recommend that the steps in the test procedure be rearranged somewhat and additional information added as follows:

> "(vi) In the evening of Day 0, sample zero air for a minimum of 12 hours. Each morning, starting on Day 1 determine the minimum and maximum readings during this period and record the difference of the readings in concentration units as the daily 12-hour zero drift. Starting in the evening of Day 1 and each evening thereafter, adjust the line voltage and room temperature according to Table B-4 before this test is begun.
>
> (vii) Each day, twenty-four (24) hours after the previous day's readings, and starting on Day 1 sample zero air and test atmospheres containing pollutant concentrations equal to 20 ± 5% and 80 ± 5% of the upper range limit. The test concentrations shall be consistent from day to day. Record the stable readings at zero and at each of the span concentrations.

(viii) Convert the readings to concentration units. Subtract each day's values respectively from that of the previous day and record as the 24-hour zero drift and span drifts at 20 and 80% of the upper range limit for that day.

(ix) Determine lag time, rise time, fall time and precision as outlined in ¶53.22(f)(5) to ¶53.22(f)(8) after the zero and span drift tests have been completed for the day.

(x) Repeat steps (vi) to (ix) daily for an uninterrupted period of seven (7) or fifteen (15) days during which no adjustments to the instrument shall be permitted. To avoid testing during weekends, the tests may be performed in three-day periods where adjustments are made on Monday and determinations are made on Tuesday, Wednesday and Thursday or adjustments may be made on Tuesday and determinations are made on Wednesday, Thursday and Friday. All adjustments to the instrument shall be made at the line voltage and room temperature of the previous day.

(xi) At the end of Day 7, examine the test results and determine whether to continue or terminate further testing as directed in ¶53.20."

5.2.9 Lag Time

The deficiencies found in this procedure were minor. The changes suggested to alleviate these are:

a. ¶53.22(f)(5)(i), line 5: Insert "equal to twice the noise" after "change" in the definition. This qualification will insure that the response observed is due to the input concentration, not instrument noise.

b. ¶53.22(f)(5)(ii)(b) change "(iv)" to "(iii)" in the sentence. The change will require the determination of lag time by sampling a pollutant concentration equal 80 ± 5% instead of the 20 ± 5% of the upper range limit and will eliminate the need to generate another concentration for the determination of rise time which immediately follows.

c. ¶53.22(f)(5)(ii)(c): Insert "equal to twice the noise" after "change" for the same reason as in ¶53.22(f)(5)(i) above.

d. ¶53.22(f)(5)(ii)(d): Add, "as the lag time", after "time".

5.2.10 Rise Time

a. ¶53.22(f)(6)(ii): Steps (b) through (e) contain several redundant steps, i.e. determining the analyzer's response at 80 ± 5% of the upper range limit when this has already been established in ¶53.22(f)(4)(iii), calculating 95% of this reading and rezeroing the instrument. We recommend the test procedure be revised, as indicated by the underscores, to read as follows:

(a) Sample zero air until stable reading is obtained.

(b) Calculate 95% of the stable reading obtained in ¶53.22(f)(4)(iii).

(c) Sample the same concentration (80 ± 5%) used in ¶53.22(f)(4)(iii) and use a stopwatch to time the interval starting with the first observable response and ending when the response equals the reading in (b) above.

(d) Record the elapsed time, and allow the analyzer to continue sampling until a stable reading is obtained in preparation for the fall time test [see ¶53.22(f)(7)(ii)].

(e) Repeat steps (a), (c) and (d) above after completion of fall time test.

(f) Report the average of the values obtained in steps (c) and (e).

5.2.11 Fall Time

a. ¶53.22(f)(7)(ii): The test procedure for fall time may be likewise shortened by combining the rise and fall time tests into one continuous operation. The changes suggested, which are indicated by the underscores, are as follows:

(a) Calculate 5% of the stable reading in (f)(6)(ii)(d) of the rise time procedure.

(b) While the analyzer is at stable reading from sampling the concentration in (f)(6)(ii)(d), switch to sample zero air and use a stopwatch to time the interval starting with the first observable instrument response due to the step change and ending when the response equals the value calculated in (a) above.

(c) Record the elapsed time.

(d) Repeat steps (a), (b) and (c).

(e) Report the average of the values obtained in steps (c) and (d).

5.2.12 Precision

a. ¶53.22(f)(8)(ii): The procedure for precision requires 6 determinations each at 20 and 80% of the upper range limit, totaling 12 determinations per day or 84 for seven days. The number of daily determinations specified appears to be excessive and not easily completed in one day. We suggest that the number of determinations be reduced to 3 each at 20 and 80% of the upper range limit. This will give a total of 6 precision values per day; 42 for the seven-day test.

This reduction in the number of determinations will allow more time to complete other tests.

We therefore recommend that this procedure be revised as indicated by the underscores to read as follows:

(a) Allow sufficient time for instrument warm-up and stabilization.

(b) Sample zero air until a stable reading is obtained. Do not record.

(c) Sample the same pollutant concentration of 20 ± 5% of the upper range as used in ¶53.22(f)(4)(vi). Record the stable reading.

(d) Sample a pollutant concentration at least 50% higher (30% of upper range limit) than in (c) above until a stable reading is obtained. Do not record.

(e) Quickly switch to the pollutant concentration used in (c). Record the reading.

(f) Add to the readings obtained in steps (c) and e), the reading on the same day for the span at 20 ± 5% of the upper range limit in ¶53.22(f)(4)(vi).

(g) Convert the readings to concentration units and calculate the mean and the standard deviation for the three values.

(h) Repeat step (b).

(i) Sample the same pollutant concentration of 80 ± 5% of the upper range limit as used in ¶(53.22(f)(4)(vi). Record the stable reading.

(j) Sample a pollutant concentration 20% higher than in (i) but not to exceed 97% of full scale. Do not record.

(k) Quickly switch to the pollutant concentration used in (i). Record the reading.

(l) Add to the readings obtained in steps (i) and (k), the reading obtained on the same day for the span at 80 ± 5% of the upper range limit in ¶53.22(f)(4)(vi).

(m) Convert the readings to concentration units and calculate the mean and standard deviation for the three values.

(n) Report the values obtained in steps (g) and (m) as the precision at 20 and 80% of the upper range limit, respectively.

b. ¶53.22(f)(8)(g): Our experiences indicate that the zero and span drift tests (Table B-4) is subject to misinterpretation [See also 5.2.1(c) of this report]. Additional directions to augment those in the test procedures are needed. Refer to Table B-4 of Appendix II or Table IX of this report for our version which we believe is clearer.

5.3 EVALUATION OF SUBPART C

Subpart C provides separate test procedures designed to demonstrate consistent relationship between candidate and reference methods for oxidants, carbon monoxide and sulfur dioxide. The test procedures require that the candidate and reference methods be operated side-by-side while sampling ambient air containing pollutant concentrations at three specified levels. The candidate method is considered to have a consistent relationship with the reference method when the differences between the respective hourly average results at each concentration level do not exceed the specified tolerances.

The test data obtained in the Phase I and II evaluation of Subpart C are shown in Tables X through XII. The results show that while none of the seven measurements made in the initial tests with the Bendix O_3 and Technicon SO_2 analyzers exceeded the tolerance specifications, the Helpar analyzer exceeded the tolerance specification once in the 24-hour measurements and five times in the 1-hour measurements. All the failures, further, occurred at the high SO_2 (0.40 to 0.50 ppm) level. According to the SO_2 and oxidant acceptance plan [¶53.34(b) of the regulations], the Melpar analyzer failed to demonstrate consistent relationship with the reference method while the Bendix and Technicon analyzers demonstrated consistent relationship with the respective reference procedures. Since the Bendix and Technicon passed the initial 7 tests and the Melpar failed, the second test consisting of 8 additional measurements was not required and therefore not conducted. The Phase I evaluation, further, showed that the three test procedures (CO, SO_2, and O_x) were essentially the same except in the test concentration ranges and in the sampling time periods required and that much of the information and test directions were repetitious. Based on these findings, the procedures in this subpart were redrafted and a single general procedure applicable to the three pollutants was developed. The revised draft is shown in Appendix III. The evaluation in Phase II of the revised procedure confirmed that the improved procedure was shorter, less confusing, informationally more complete and more direct. It has the advantage of being adaptable to other methods by simply appending the application and by adding the specific information, test specifications, appropriate sampling plans and appropriate interpretation criteria to the directions.

The above results, however, does not mean that all Melpar units are incapable of demonstrating consistent relationship. As stated in 3.4 of this report, all the test instruments were used units and all required some repair and maintenance to make them operational. In particular, a shorted igniter and a frosted heat-shield window of the reaction chamber were replaced in the Melpar unit, just prior to initiating evaluation of Subpart C. Subsequent calibration curves no longer corresponded to the normal log-linear response obtained in the earlier evaluation of Subpart B. The response, moreover, appeared to be disproportionately less sensitive at the higher (>0.35 ppm) test gas concentrations in comparison to earlier data. We believe however, that these deficiencies did not interfere with the objective of evaluating the test procedure and not the analyzers.

5.4 REVIEW OF RESPONDENTS' COMMENTS

The comments of the respondents are categorized and tabulated in Appendix IV by subject matter. In most cases, it was found that the comments were already covered in the regulations and/or in the AIHL's progress reports to EPA. In some instances, new information were cited. The merits of which should be considered in the final version of the regulations. The AIHL remarks and recommendations are appended to the comments.

In general the comments indicated that the proposed regulations have been well received by most of the respondents. Five respondents (#19, 23, 24, 26 and 27) offered commendations for a piece of work well done while six expressed support for the intent and provisions of the regulations. Only one respondent questioned the basis and need for such regulations. Two respondents thought the development of such regulations should include or be a function of professional standard organizations such as ASTM, ANSI or NBS while one (#22) voiced a fear that the provisions could jeopardize the outcome of analyzer evaluation studies currently conducted by Southwest Research Institute, ASTM and Midwest Research Institute if the test procedures of the proposed regulations are not congruent with those of the studies.

6.0 MANPOWER REQUIREMENTS AND COSTS

The time to establish equivalency obviously depends on 1) the mechanism required; i.e., whether Subpart B, C or both are required, 2) the analyzer response time characteristics, 3) the speed with which the test gas concentrations can be verified, 4) the number and kinds of interferent test gases required and, 5) the performance of the analyzer; i.e., number of failures encountered. The man-hours required to conduct the procedures in Subparts B and C are shown in Tables XIII through XIV and discussed below.

6.1 SUBPART B

As explained in 5.0 of this report, the evaluation of the procedures for noise, lower detectable limit and interference equivalent were conducted only once. While the values for these parameters in Table XIII refer to the time required to conduct each test seven times, they are, in fact, extrapolated values based on the results of single trials.

The data in Table XIII show that the total man-hours required to conduct the seven trials in Subpart B ranged from 482 to 1452 man-hours. The data further indicate that the slow responding Technicon unit required the most time (1452 man-hours) and that the faster responding Melpar and Bendix units were approximately equal (482 and 502 man-hours, respectively). The data also indicate that approximately 50% of the Technicon and Melpar times and 72% of the Bendix times could be attributed to the tests for interference equivalent. The values reported in Table XIII include the times for familiarization with the analytical procedures for verifying the reference and interferent test gas concentrations, preparation and standardization of reagents, etc. In ongoing, routine programs, some of these activities may occur only occasionally. For such cases, the man-hours allocated for this purpose may be subtracted and thus reduce, to some extent, the time to demonstrate equivalency.

Details regarding the costs and man-hour requirements for the individual tests and the gas generation system are discussed below.

6.1.1 Gas Generation System

To provide the pollutant and interferent test gas concentrations specified in Subpart B, a gas generation system is required. Our records show that the design, fabrication and installation of the system described in 3.2 of this report required about 176 man-hours at a cost of about $4700 for materials. This cost is broken down as follows:

$1000	Cost of parts and materials
3400	Cost of instrumentation (i.e., mass flowmeter, strip-chart recorder, constant temperature bath)
300	Cost of permeation tubes and cylinders of other reference and test gases.
$4700	Total

In addition, about $1000 should be added to the above to cover the cost of approximately 34 cylinders of zero air needed to conduct the performance test procedures.

6.1.2 Calibration [53.21(c)]

Table XIII shows that to calibrate each analyzer separately would require about 80 man-hours for the Technicon, 64 for the Melpar and 16 for the Bendix. These times do not include a variety or "overhead" items, such as staff leave time, erroneous starts and supervision. The times for the Technicon and Melpar may be allocated as follows: 1) 24 man-hours to calibrate the spectrophotometer for the pararosaniline reference method[10], 2) 24 man-hours to prepare the Technicon for operation and calibration, 16 man-hours for the Melpar, and 3) the remaining time to generate the necessary SO_2 gas streams, and to conduct the calibration.

The time for calibrating the spectrophotometer includes the time to prepare all glasswares, reagents, and standardization of the reagents. The times to prepare the analyzers for operation and calibration include familiarization with the instruments, interfacing the outputs with strip chart recorders, photometer alignment (Technicon), maintenance, installation of auxilliary accessories and calibration of the flowmetering devices. It does not include the time spent to troubleshoot and repair malfunctions. The time required to obtain the actual calibration data includes the generation of seven calibrating gas concentrations, manual collection of samples for verification, analysis of the collected samples and sampling the gas streams with the analyzer.

6.1.3 Noise [53.22(b)] and Lower Detectable Limit [53.22(c)]:

The data in Table XIII indicates that the times to conduct the seven trials for noise and lower detectable limit with the Melpar and Technicon units were up to twice that of the Bendix. Although the speed of response of the Bendix and the Melpar are similar, the minimum test period for the Melpar unit is restricted by the test gas verification scheme. The manual pararosaniline reference method for SO_2 requires up to 30 minutes for sample collection and additional 30 minutes for analysis whereas the verification scheme for ozone requires five to ten minutes for sample collection and 15 minutes for analysis.

6.1.4 Interference Equivalent [53.22(d)]:

The determination of interference equivalent depends not only on the response time characteristics of the analyzer but also on the measurement principle used to detect the pollutant since this fact will determine the number and types of interferents to be tested. Of the 12 potential interferents listed in Table B-3 of the regulations, Table XIII shows that 700 man-hours would be required to evaluate the effect of the seven interferents listed for the colorimetric principle (Technicon) for SO_2 whereas 252 man-hours are required for the three interferents listed for the flame photometric (Melpar) and 364 man-hours to test the four interferents for the chemiluminescent ozone (Bendix). As observed in 6.1 above, these times constituted approximately 50% of the total time required for determining the performance of the Technicon and Melpar units and 72% of the time for the Bendix. The times given for each interferent equivalent includes familiarization with the individual method, preparation of spectrophotometer calibration curve, generating the desired interferent test concentration, verifying the concentration, and all calculations.

6.1.5 Zero Drift, Span Drift, Precision, Rise Time, Fall Time and Lag Time [53.22(f)]:

This procedure calls for conducting the tests for these parameters once a day over a period of at least seven days, of which at least three-day periods must be contiguous. The procedure further provides separate test procedures for each parameter inferring that each test is to be conducted as a separate entity. The procedure further stipulates that as a part of the test for zero drift, the test instrument is to sample zero air daily for a period of no less than 12 hours. But, since this test is conducted during the night-time hours unattended, the man-hours for this test indicated in Table XIII were not included in the total man-hours.

The evaluation of this procedure revealed, as expected, that with instruments with response time characteristics on the order of t_{95} = 13 sec such as the Bendix and Melpar analyzers, all the daily tests could be completed during a normal workday. However, with the slow-responding Technicon analyzer (t_{95} = 41 min), only the drift and response time tests could be completed in one normal workday, leaving insufficient time to perform the test for precision. Furthermore, with the Technicon, at least 32 man-hours would be required to obtain the precision values specified in Table B-4 for a single day and 224 man-hours to repeat each test each day for seven days.

On the other hand, the data in Table XIII also show that the tests for response times (lag, rise and fall times) required a total of 63 man-hours for the Technicon and 18 man-hours for the Melpar and Bendix. However, these tests can be conducted in conjunction with the tests for precision with no increase in man-hours. By combining these tests, the net man-hours could be reduced somewhat to 1388 vs 1452 for the Technicon, 464 vs 482 for the Melpar and 484 vs 502 for the Bendix.

6.2 SUBPART C

The data in Table XIV show that in contrast to the evaluation of Subpart B, the test analyzer performance were of little consequence because the test procedure calls for making 1-hour and 24-hour average measurements. Thus, the man-hours required to establish consistent relationship is primarily a function of the test plan requirements as indicated by the identical values for the SO_2 analyzers and the somewhat lower values for the O_x analyzer. Finally, Table XIII shows that the additional time to conduct the second test series is only about 25% even though the number of samples to be taken is somewhat greater since many of the preparatory-type operations have already been completed during the first test series.

Table XIV also shows the man-hours required to design, fabricate and install the sampling probe excluding any gas generation system.

6.2.1 Sampling Probe and Manifold

The cost of the air sampling system described in 3.3 of this report was relatively inexpensive. The glass pipes for the ducting are available from most plumbing supply houses and can be purchased in about 2 or 3 standard lengths of up to 10 ft. The sampling manifold was the most expensive component ($70.00) of the air sampling system because it was specially designed and fabricated. As shown in Table XIV, approximately 80 man-hours were required to design, construct and install the entire sampling system. The cost was about $180.00 excluding labor. The costs of the mass flowmeter, strip-chart recorder and constant temperature bath were not considered since they are a part of the gas generation system described in 3.2 of this report.

6.2.2 Oxidant Methods [53.31]

As can be seen in Table XIV, exclusive of the time to construct and install the sampling probe, approximately 104 hours were required to obtain the initial 14 measurement for consistent relationship with the oxidant (Bendix) analyzer.

When the second sample set consisting of 18 measurements is required, it is estimated about 72 additional man-hours will be needed. The time to conduct the second sample set is less because the instruments need not be calibrated again. This will make the total number of man-hours about 256 or 176 excluding the sampling probe.

6.2.3 Carbon Monoxide (CO) Methods:

This procedure (¶53.32 of the regulations) is essentially identical to that for oxidant methods. Therefore, not only do the recommendations for improving the oxidant procedure apply to this method but due to the similarity in the response time characteristics of these instruments to the Bendix oxidant analyzer, it is estimated that the man-hours required to conduct this test would essentially be the same as that for the oxidant method.

6.2.4 Sulfur Dioxide Methods

Based on our experiences with the Melpar and Technicon analyzers, it is estimated that excluding the sampling probe, it would require a minimum of 154 man-hours to conduct the first sample set and, in the event of one or two failures, an additional 72 man-hours to obtain the eight measurements required for the second set for a total of about 226 man-hours. With the time to design, construct and install the sampling probe systems included, the time needed to conduct the first sample set is increased to about 234 man-hours, and to 306 man-hours in the event the second sample set is required.

6.3 OVERALL TIMES

Table XV summarizes the data shown in Tables XIII and XIV and shows the total man-hours required by each analyzer to conduct the tests for performance and consistent relationship. The table shows that in addition to the man-hours for the design, fabrication and installation of the gas generation system and the sampling probe, the Technicon analyzer would require about 1540 man-hours to conduct the initial test set for both performance and consistent relationship, the Melpar about 570 and the Bendix about 590. In the event a second test set is required, the total man-hours increases to about 3110 man-hours for the Technicon and 1200 man-hours for the Melpar and Bendix.

These results indicate that cost of determining equivalency depends on the operating principles and characteristics as well as the performance of the candidate analyzers and that the determination process may be as short as 104 man-hours when consistent relationship only is required to as long as 3110 man-hours in the event all contingencies are required. The data in Table XIII further indicate that a substantial proportion (between 50 to 75%) of the effort to determine performance may be attributed to the determination of interference equivalent.

6.4 CERTIFICATION

For equivalency certification, the regulations require, in addition to specified sworn statements, other data and information that must be submitted to EPA. These include a) all appropriate performance and consistent relationship data obtained in Subpart B and C including recorder chart tracings, test data and any other documentation, b) detailed description of the candidate method including the measurement principle, manufacturer's identifications, components, diagrams and other relevant items, c) a description of the quality control program used to insure that all the measurement systems will have the same performance characteristics as the candidate method, and d) a description of the calibration and operational procedures prescribed for field use of the method.

Based on the experience encountered in the evaluation of the regulations, it is estimated that between 80 to 120 man-hours will be required to check, verify and interpret the submissions for each method provided all necessary information are included and that confirmatory laboratory testing is not required.

7.0 SUMMARY AND CONCLUSIONS

The federal Environmental Protection Agency has proposed the equivalency regulations as a standard set of procedures for establishing the equivalency of non-reference analytical methods to reference methods which are prescribed by the Federal Clean Air Act for the measurement of ambient air quality. To assess the applicability, validity and workability of the regulations and to determine the costs to demonstrate equivalency, the provisions, specifications and test procedures of the regulations were evaluated in two phases using three automated methods or analyzers and two manual methods. The comments regarding the proposed regulations submitted to EPA by respondents were also reviewed.

The evaluation revealed that the provisions and specifications given are by-and-large consistent with prevailing ambient air measurement technology. Some of the test procedures and general instructions, however, were found to be deficient.

The deficiencies found consisted of unclear test directions, inconsistent test requirements, insufficient description of the gas generation system, redundant test information and procedures, missing performance specifications, poorly organized procedural steps and typographical errors.

Subpart A of the regulations was found to be adequate and only requires a minor improvement by the inclusion of a clear statement stipulating that the instruments or analyzers and not measuring principles are to be certified for equivalency. Substantial changes were made in Subparts B and C resulting in the redrafting of these two subparts.

The changes made in Subpart B included, a) clarifying or supplying the missing or proper test information, b) reorganizing some of the procedural steps for proper sequence, c) developing a more reliable gas generation and verification procedure for lower detectable limit, d) revising the test procedure for noise to require conversion of the DM readings to concentration units first before treatment of the data to accommodate instrument outputs that are not proportional to the input concentrations, 3) recommending that the conversion of the analyzer readings to concentration units be accomplished by reference to the slope of the best-fit curve rather than by the graphical reference to the plot of the curve for better accuracy, f) improving the procedures for drifts and response times by eliminating unclear test directions and by making the test information correspond to that in the prescribed test plan, and g) modifying the test procedure for precision by reducing the number of trials required to accommodate slower responding instruments.

In subpart C, the redundant test procedures for SO_2, CO and Ox were combined into a general procedure applicable to all three methods.

The cost in man-hours to establish equivalency depends on several factors such as, a) the mechanism required (meet performance only, consistent relationship only or both), b) the number and kinds of interferent test gases required, c) whether additional tests are required, d) speed of response of the method under test, and e) time needed to generate and verify the test gas concentrations. Thus, two analyzers of different configuration but using the same measurement principle can differ greatly in their equivalency time requirement. On a routine basis, it is estimated that equivalency determination may require from as little as 100 to much as 3110 man-hours depending on the performance of the candidate method.

It is further estimated that to review the voluminous test data that will be submitted for equivalency certification will require between 80 to 120 man-hours per method assuming all necessary information is available and no additional tests are required.

Lastly, considering the significance of the proposed rulemaking and the number of air analyzer manufacturers and users throughout the country, the 29 communications received by EPA from respondents appeared quite small.

The comments, however, were generally favorable. Only a small minority believed such regulations should be a function of organizations such as ASTM or NBS. Many of the technical questions raised in the communications had already been answered in the AIHL's bimonthly progress reports to EPA. In some cases, suggestions and information previously not considered were discussed by the respondents. EPA should consider their merits in the final version of the regulations.

8.0 REFERENCES:

1. Federal Register, Volume 38, no. 197, (Oct. 12, 1973)
2. Environmental Chamber, Frigitemp Corp., Brooklyn, NY 11212
3. Fisher and Porter Co., Lab Crest Div., Warminster, PA
4. Hastings - Raydist, Hampton, VA 23361
5. AIRCO Industrial Gases, P.O. Box 785, Oakland, CA 94604
6. Corning Glass Works, 500 Smith Main St., Orange, CA 92668
7. Technicon Industrial Systems, Tarrytown, NY
8. Meloy Laboratories, Inc., 6631 Iron Place, Springfield, VA 22151
9. Bendix Corporation, 1400 Taylor Avenue, Baltimore, MD 21204
10. Federal Register, Vol 35, No. 2273, (November 25, 1971)

TABLE 1

Analyzers Used for Evaluating EPA's Proposed Equivalency Regulations

Manufacturer	Model	Pollutant	Principle	Sampling Rate 1/min	Response Times[(a)]		
					Lag	Rise	Fall
Bendix Corporation Ronceverte, W Va		O_3	Chemiluminescent	1.0	≤3secs	≤10secs	≤10secs
Melpar, Inc. Falls Church, Va	LL-1100-1B	Total Sulfur	Flame Photometric	0.200			
Technicon Instr. Corp. Tarrytown, NY	IV	SO_2	Colorimetric (pararosaniline)	0.40	11.5 min	3 min	4.0 min

(a) Manufacturer's specifications

TABLE II

Questions and Suggestions on Subpart B of the Regulations Submitted to the Project Officer

(April 1973 Draft)

PAGE	SECTION	ITEM
15	53.20(d)	In Table B-1, the specifications for zero drift are given for 12 and 24 hours. No time interval is specified for span drift. What is the time element required for span drift?
16	53.21	This section specifies that the "temperature of the gas generation system shall be maintained within 2°C to assure stable output" [¶ (a)] and that the "test gas concentration shall be consistent from day to day [53.22(f)(4)(vi)]". In the test procedures for performance, however, it is required that tests for zero and span drifts (Table B-4) shall also be conducted at 20 and 30°C. Does this mean that two temperature-controlled test rooms or chambers, one for the instruments under test and one for the gas generation system, are required? If a change in the gas concentration does occur, how much can be tolerated? Can correction factors be used?

TABLE II (con't)

PAGE	SECTION	ITEM
16	53.21	Since, our test facility houses both the gas generation system and the analyzers, this situation poses a problem because the change in chamber temperature may affect the test gas concentration as well as the analyzers. We propose either one of the following alternate solutions: 1) adjust the concentration of the test gas back to the reference concentration after the test room has equilibrated to the new test temperature. This technique might require several determinations and consequently time-consuming, or 2) it may be more expedient to calculate the resulting concentration of the test gas at the new test temperature. The instrument output can then be related back to the reference gas concentration.
20	53.22(b) (2)(iii)	The test procedure calls for use of "Digital Voltmeter (DVM) accurate to four significant figures with one-second time constant on the input...." A voltmeter with these specifications and with lower measuring range of 0 to

TABLE II (con't)

PAGE	SECTION	ITEM
20	53.22(b) (2)(iii)	100 mv costs approximately $1700 and is not readily available. The cost increases substantially when a lower range capability of 0 to 1.0 mv is required for some analyzers. The response times of reasonably priced (about $650) DVM's are on the order of milliseconds and microseconds. How critical is the one-second time constant requirement?
33	53.22(f)(5)	Lag time is defined in the regulations as "the time interval between a step change in input concentration at the instrument inlet to the first observable change equal to twice the noise in the instrument output." However, in the test procedure, only the time to the "first observable change" is cited. For consistency, the working in the test procedure should correspond with the definition. Also, the same criterion should be used in the test procedures for determining rise time [¶(6)(ii) and fall time ¶(7)(ii)].

TABLE II (con't)

PAGE	SECTION	ITEM
20 to 39	53.22... 53.30	Numbering skipped from 53.22 to 53.30. Is 53.23 to 53.29 missing?
15	53.20(d) (7)	Delete 95% after lag time.
25	53.22(d) (2)(iii)	Change the designation of the interferent gas to "y" and zero air to "Z". This change will make the latter easier to remember.
35	53.22(f) (7)(ii)(d)	Should read "Repeat paragraph (a) to (c)".
36	53.22(f) (8)(ii) (1) & (k)	"Switch to sample" should be used in place of "Rapidly reduce". This is to insure unchanged test gas concentration for the repeat determination.

TABLE III

Recommended Changes in Subpart C of the Equivalency Regulations

(April 1973 Draft)

I. Editorial and Typographical Changes:

Page	Paragraph	Line	Change
40	53.30 (c)	1	Change "party" to "applicant". The latter is defined in the general provisions of the Regulations.
40	53.30 (c)	5	Correct the spelling of "identifiied" to "identified".
40	53.30 (e)	1	Correct "relationshiip" to "relationship".
		4	Correct "vallues" to "values".
40	53.31 (a)(1)	2	Correct "aaccordance" to "accordance".
		3	Correct "approppriate" to "appropriate".
41	53.31 (a)(3)	6	Correct "permissable" to "permissible".
41	53.31 (b)(1)	3	Correct "0.06-1.1 ppm" to "0.06-0.1 ppm".
42	53.31 (d)	1	Relabel paragraph from "(d)" to "(c)".
43	53.31 (c)(Table C-1)	1	Relabel Table C-1 from "(c)" to "(d)".
43	53.31 (d)(Table C-1)		Delete the "<"sign in the tolerance column and replace with "+" sign above the minus sign to read "±".
43	53.31 (d)(Table C-1)		Correct the sample size for the first samples in the medium concentration range from "5" to "4" and, in the high range from "4" to "5".
46	53.32 (3)	7	Correct "permissable" to "permissible'

51	53.33 (a)(3)	3	Correct "permissable" to permissible".
52	53.33 (b)(3)	2	Correct "section 53.31(c)" to "¶ 53.31 (d)".
54	53.34	2	Add "for sulfur dioxide" after "method" for clarity.
		3	Change "party" to "applicant". Applicant is defined in the general provisions of the Regulations.
55	53.35 (a)(1)(iii)	8	Correct "permissable" to permissible".
56	53.35 (b)(Table C-3)		Correct "allowable number of differences which can fail tolerance specification" to "allowable number of tolerance differences to pass consistent relationship specifications".
57	53.35 (b)(1)(i)(a)	4	Change "instrument" to "method" for consistency in terminology.
57	53.35 (b)(1)(i)b	4	Same as above.
60	53.35 (d)(1)(v)	2	Change "means of" to "the".
		11	Correct "3-hour" to "1-hour".
60	53.35 (d)(1)(vi)	1	Correct "section" to "¶" for consistency in terminology.
62	53.35 (d)(3)	4	Correct "four" to "three".
		8	Correct "3-hour" to "1-hour".
		10	Correct "3-hour" to "1-hour".

II. Technical Changes and Improvements:

Page	Paragraph	Change
40	53.31 (a)(2)	Add after the last sentence, "In the absence of a manufacturer's calibration procedure, perform dynamic calibration with at least 7 identifiable points including 0 and 90% of full scale using the appropriate method in 40 C.F.R. Part 50."

41	53.31 (a)(3)	Add after the last sentence of the paragraph, "When control samples indicate deviations of greater than ± 5% in the instrument response from the latest calibration, discontinue testing. The deviations indicate possible calibration shift or instrument malfunction. Consult the instruction manual or the manufacturer and correct the cause of the problem. Perform calibration and restart the testing from the beginning of the operational period" The inclusion of the above will provide a course of action when control checks indicate that the instrument is out of performance specification.
41	53.31 (b)(2)	Add after "methods", (i.e., eyeball, planimeter, etc.)". The addition of this phrase will alert the applicant of the types of methods needed.
42	53.31 (b)(3)	Delete the whole paragraph. It is a repeat of what is discussed in detail in the sampling procedure (¶ 53.31 (c)).
45	53.31 (f)(2)	Revise the first sentence to, "If the number of measurements from the series of 14 which fail the stated specification is one or two, conduct a second set of 18 measurements". This will make the sentence conform in intent and format to the procedures and for the other pollutants.
46	53.32 (a)(2)	Add after "manufacturer" the change recommended for page 40 of the Regulations, ¶ 53.31 (a)(2).
46	53.32 (a)(3)	Add after the last sentence of the paragraph the change recommended for page 41, ¶ 53.31 (a)(3).
47	53.32 (b)(3)	Delete the paragraph. It is redundant since the content is discussed in detail in ¶ 53.32 (c).
50	53.33 (a)(2)	Continue at the end of the sentence with the recommendation given for page 40, ¶ 53.31 (a)(2).
51	53.33 (a)(3)	Add at the end of the paragraph the change recommended for page 41, ¶ 53.31 (a)(3).
52	53.33 (b)(3)	Delete the paragraph. The content is a repeat of what is discussed in detail in ¶ 53.33 (c).

55	53.34 (a)(1)(ii)	Add at the end of the paragraph the change recommended for page 40, ¶ 53.31 (a)(2).
55	53.34 (a)(1)(iii)	Add after "specifications" on line 14 the change developed for page 41, ¶ 53.31 (a)(3). Delete the last sentence of the paragraph. The reference method is a manual method requiring a 24-hour integrated sample. It is virtually impossible to introduce control samples in the collected sample itself.
56	53.34 (a)(2)	Revise the last two sentences of the paragraph to read, "The average response of the automated method over the 1-hour span corresponding to the 1-hour reference sample shall be determined by integration of the continuous signal output or by the average of at least 12 instantaneous signal levels at equally spaced intervals over the 1-hour sampling period. In like manner, the 24-hour average response of the automated method is obtained by integrating at least 22 hours of the continuous output signal during the 24-hour measurement." The average over 22-hours is recommended since, some time is needed to introduce control samples and when waiting for the system to come to equilibrium when the step changes in pollutant concentration are made. A full 24-hour average means that the operational period will be longer than the 72 hours.
58	53.34 (b)(2)	Delete the first two sentences. The content is a repeat of what is discussed in the following paragraph.
62	53.34 (d)(3)	Delete the first sentence. It is superfluous.

TABLE IV

Changes Authorized or Requested by EPA

SECTION	CHANGES
¶ 53.21(a)	increase the allowable fluctuation of the environment around the gas generation system from ± 1°C to ± 2°C.
53.22(f)(5)(i)	delete the clause "equal to twice the noise" in the technical definition of lag time to read, "the time interval between a step change in input concentration at the instrument inlet to the first observable corresponding change." Although this change will make the definition consistent with the test procedure, in our opinion, this will not give a true value for lag time because of the difficulty in discerning whether the first observable change in response is due to the introduction of pollutant or due to analyzer noise. We would still recommend that the directions in the test procedure and not the definition be revised. See 5.2.9, Item (a) for additional comments.
¶ 53.30(a)	delete the Priority Region 1 site requirement for conducting the consistent relationship tests. This will eliminate the necessity for testing at sites which may be several hundred miles away from the manufacturer's location and may prove to be prohibitively expensive.

¶ 53.30(a) increase the maximum allowable volume dilution of the ambient air sample from 20 to 40% when spiking to obtain the desired pollutant concentration for consistent relationship tests.

¶ 53.34(a)(2) In the consistent relationship test for SO_2, reduce the 3-hour measurements to 1-hour for the tests at the 0.40 to 0.50 ppm range.

The 1-hour requirement appears inconsistent with the federal air quality standard for SO_2, which calls for 3-hour average.

TABLE V

EVALUATION OF SUBPART B USING SO_2 ANALYZERS (PHASE I)

PROCEDURE TESTED	ANALYZER USED	SPECIFICATION	TEST RESULT	PASSED OR FAILED	STATUS OF PROCEDURE
Calibration	(T)		See Fig. 3		Improvements are needed. See 5.2.3
	(M)		See Figs. 4 & 5		
Range	(T)		0-1.0 ppm		No change needed
	(M)		0-1.0 ppm		
Noise, 0%	(T)	0.005 ppm	<0.01 ppm	Failed	Modifications are needed. See 5.2.4
	(M)	0.005 ppm	<0.005 ppm	Passed	
Noise, 80%	(T)	0.005 ppm	0.008	Failed	Specification missing in Regulations.
	(M)	0.005 ppm	<0.005	Passed	
Lower Detectable Limit	(T)	0.02 ppm	0.01 ppm	Passed	Improvements are needed. See ¶ 5.2.5
	(M)	0.02 ppm	0.01 ppm	Passed	
Lag Time	(T)	20 min	15.57 min	Passed	Change needed
	(M)	20 min	0.05 min	Passed	
Rise Time	(T)	15 min	24.87 min	Failed	Improvement needed. See ¶ 5.2.7
	(M)	15 min	0.16 min	Passed	
Fall Time	(T)	15 min	26.68 min	Failed	Improvement needed. See 5.2.7
	(M)	15 min	2.89 min	Passed	
Precision, 20%	(T)	0.02 ppm	NC	--	Modifications needed. See 5.2.7
	(M)	0.02 ppm	0.003 ppm	Passed	
Precision, 80%	(T)	0.03 ppm	NC	--	Modifications needed. See 5.2.7
	(M)	0.03 ppm	0.008 ppm	Passed	

Interference Equivalent:					Improvements needed. See 5.2.2 and 5.2.6 of this report
HCl	(T)	± 0.02 ppm	<0.02	Passed	
	(M)		NR	—	
NH_3	(T)	± 0.02 ppm	<0.02	Passed	Collected samples nee to be neutralized before analysis. See Item (d) under discussion in 5.2.2
	(M)		NR	—	
H_2S	(T)	± 0.02 ppm	<0.02	Passed	
	(M)		+ 0.045	Failed	
NO_2	(T)	± 0.02 ppm	<0.02	Passed	
	(M)		NR	—	
CO_2	(T)	± 0.02 ppm	<0.02	Passed	Higher concentration of stock CO_2 needed. See Item (c) under di cussion in 5.2.2
	(M)		0.065	Failed	
O_3	(T)	± 0.02 ppm	<0.02	Passed	
	(M)		NR	—	
H_2O	(T)	± 0.02 ppm	NR	—	Specified concentrati of H_2O impractical. See Item (g) under di cussion in 5.2.2
	(M)		<0.02	Passed	
CO	(T)	± 0.02 ppm	NR	—	Higher concentration of stock CO needed. See Item (d) under di cussion in 5.2.2
	(M)		<0.02	Passed	
Total Interferent	(T)	0.06	0.045	Passed	
	(M)	0.06	0.114	Failed	

NOTE: (T) - Technicon Air Monitor IV; (M) - Melpar sulfur analyzer; (NC) - Analyzer response times did not permit completic in time allotted; (NR) - not required.

TABLE VI

EVALUATION OF SUBPART B FOR ZERO AND SPAN DRIFTS USING THE MELPAR TOTAL SULFUR ANALYZER - PHASE I

(Specification for zero and span drifts = ± 0.02 ppm)

PROCEDURE TESTED	INPUT SO_2 (ppm)	TEST PERIOD DAY #	CHANGE IN RESPONSE (ppm)	RESULTS (PASSED OR FAILED)	COMMENTS
24-hour at zero	0	0	----	----	Instrument passed for this specification.
		1	0	Passed	
		2	0	Passed	
		3	0	Passed	
		4	0	Passed	
		5	0	Passed	
		6	0	Passed	
		7	0	Passed	
12-hour at zero	0	0	----	----	Instrument passed for this specification.
		1	0	Passed	
		2	0	Passed	
		3	0	Passed	
		4	0	Passed	
		5	0	Passed	
		6	0	Passed	
		7	0	Passed	
24-hour span 20% of full scale	0.20	0	----	----	Instrument failed this specification.
		1	-0.01	Passed	
		2	+0.01	Passed	
		3	-0.02	Passed	
		4	+0.03	Failed	
		5	-0.01	Passed	
		6	-0.03	Failed	
		7	+0.04	Failed	
24-hour span at 80% of scale	0.77	0	----	----	Instrument failed this specification.
		1	-0.02	Passed	
		2	+0.0	Passed	
		3	+0.01	Passed	
		4	----	----	
		5	-0.04	Failed	
		6	-0.04	Failed	
		7	+0.04	Failed	

TABLE VII

EVALUATION OF SUBPART B FOR ZERO AND SPAN DRIFTS USING THE TECHNICON SO_2 ANALYZER - PHASE I

(Specification for zero and span drifts = ± 0.02 ppm)

PROCEDURE TESTED	INPUT SO_2 (ppm)	TEST PERIOD DAY #	CHANGE IN RESPONSE (ppm)	RESULTS (PASSED OR FAILED)	COMMENTS
24-hour zero test	0.0	0	----	----	A second series of 8 tests is indicated.
		1	0.0	Passed	
		2	+0.035	Failed	
		3	-0.01	Passed	
		4	0.0	Passed	
		5	+0.01	Passed	
		6	-0.01	Passed	
		7	+0.05	Failed	
12-hour zero test	0.0	0	----	----	Instrument failed this specification.
		1	0.05	Failed	
		2	0.015	Passed	
		3	0.03	Failed	
		4	0.07	Failed	
		5	0.02	Passed	
		6	0.0	Passed	
		7	0.04	Failed	
24-hour span at 20% of scale	0.21	0	----	----	Instrument failed this specification.
		1	0.0	Passed	
		2	0.0	Passed	
		3	+0.04	Failed	
		4	-0.02	Passed	
		5	+0.05	Failed	
		6	-0.01	Passed	
		7	+0.04	Failed	
24-hour span at 80% of scale	0.83	0	----	----	A second series of 8 tests is indicated.
		1	+0.005	Passed	
		2	+0.015	Passed	
		3	+0.03	Failed	
		4	-0.01	Passed	
		5	+0.02	Passed	
		6	+0.005	Passed	
		7	0.0	Passed	

TABLE VIII

EVALUATION OF IMPROVED SUBPART B(a) USING THE BENDIX OZONE MONITOR (PHASE II)

Procedure(a) Tested	Specification	Test Result	Passed/ Failed	Status of Procedure(a)
Calibration				Procedure O.K.
Range	0.0-0.5 ppm	0.0-0.5 ppm	Passed	
Noise, 0% of Range	0.005 ppm	0.0 ppm	Passed	Procedure O.K.
, 80% of Range	0.01 ppm	0.0 ppm	Passed	
Lower Detectable Limit	0.01 ppm	0.01 ppm	Passed	Procedure O.K.
Interference Equivalent				Procedure O.K.
H_2S	±0.02 ppm	0.0 ppm	Passed	
CO_2	±0.02 ppm	0.0 ppm	Passed	
H_2O	±0.02 ppm	0.0 ppm	Passed	
TOTAL	0.06 ppm	0.0 ppm	Passed	
Zero Drift(b), 12-Hr:				Procedure O.K.
Day 1	±0.02 ppm	0.0 ppm	Passed	
2	±0.02 ppm	0.0 ppm	Passed	
3	±0.02 ppm	0.0 ppm	Passed	
4	±0.02 ppm	0.0 ppm	Passed	
5	±0.02 ppm	0.0 ppm	Passed	

TABLE VIII (cont'd)

Procedure Tested	Specifications	Test Result	Passed/ Failed	Status of Procedure
6	±0.02 ppm	0.0 ppm	Passed	
7	±0.02 ppm	0.0 ppm	Passed	
Zero Drift$^{(b)}$, 24-Hr Day 1	±0.02 ppm	0.0 ppm	Passed	Procedure O.K.
2	±0.02 ppm	0.0 ppm	Passed	
3	±0.02 ppm	0.0 ppm	Passed	
4	±0.02 ppm	0.0 ppm	Passed	
5	±0.02 ppm	0.0 ppm	Passed	
6	±0.02 ppm	0.0 ppm	Passed	
7	±0.02 ppm	0.0 ppm	Passed	
Span Drift$^{(b)}$, 80% of Range Day 1	±0.02 ppm	0.0 ppm	Passed	Procedure O.K.
2		0.0 ppm	Passed	
3		0.02 ppm	Passed	
4		0.00 ppm	Passed	
5		0.01 ppm	Passed	
6		0.01 ppm	Passed	
7		0.01 ppm	Passed	

TABLE VIII (cont'd)

Procedure Tested	Specification	Test Result	Passed/ Failed	Status of Procedure
Lag Time(b):				
Day 1	1200 Secs	3 Secs	Passed	Procedure O.K.
2	1200 Secs	4 Secs	Passed	
3	1200 Secs	3 Secs	Passed	
4	1200 Secs	3 Secs	Passed	
5	1200 Secs	3 Secs	Passed	
6	1200 Secs	3 Secs	Passed	
7	1200 Secs	3 Secs	Passed	
Lag Time(b):				
Day 1	1200 Secs	3 Secs	Passed	Procedure O.K.
2	1200 Secs	4 Secs	Passed	
3	1200 Secs	3 Secs	Passed	
4	1200 Secs	3 Secs	Passed	
5	1200 Secs	3 Secs	Passed	
6	1200 Secs	3 Secs	Passed	
7	1200 Secs	3 Secs	Passed	
Rise Time(b):				
Day 1	900 Secs	39 Secs	Passed	Procedure O.K.
2	900 Secs	31 Secs	Passed	

TABLE VIII (cont'd)

Procedure Tested	Specification	Test Result	Passed/ Failed	Status of Procedure
3	900 Secs	28 Secs	Passed	
4	900 Secs	31 Secs	Passed	
5	900 Secs	32 Secs	Passed	
6	900 Secs	32 Secs	Passed	
7	900 Secs	33 Secs	Passed	
Fall Time(b):				
Day 1	900 Secs	32 Secs	Passed	
2	900 Secs	33 Secs	Passed	
3		34 Secs	Passed	
4		32 Secs	Passed	
5		32 Secs	Passed	
6		32 Secs	Passed	
7		32 Secs	Passed	
Precision(b), @ 20% of Range				Procedure O.K.
Day 1	±0.02 ppm	0.0 ppm	Passed	
2	±0.02 ppm	0.0 ppm	Passed	
3	±0.02 ppm	0.0 ppm	Passed	

TABLE VIII (cont'd)

Procedure Tested	Specification	Test Result	Passed/ Failed	Status of Procedure
4	±0.02 ppm	0.0 ppm	Passed	
5	±0.02 ppm	0.0 ppm	Passed	
6	±0.02 ppm	0.01 ppm	Passed	
7	±0.02 ppm	0.01 ppm	Passed	
Precision(b), @ 80% of Range				Procedure O.K.
Day 1	±0.02 ppm	0.0 ppm	Passed	
2	±0.02 ppm	0.0 ppm	Passed	
3	±0.02 ppm	0.0 ppm	Passed	
4	±0.02 ppm	0.0 ppm	Passed	
5	±0.02 ppm	0.0 ppm	Passed	
6	±0.02 ppm	0.0 ppm	Passed	
7	±0.02 ppm	0.0 ppm	Passed	

TABLE IX

Suggested Zero and Span Drift Test Plan[a]: Table B-4

Day	Morning	Every Night[e] Adjust Test Conditions to: Line Voltage[c]	Room Temp,°C[d]	Day
0	Adjust zero and Span 1 (80 ± 5% of range). Sample Span 2 (20 ± 5% of range). Record the stable readings. No instrument adjustments permitted hereafter until after Day 3 readings.	125	20	0
1	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2, 24 hours after Day 0 readings.	105	20	1
2	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	125	30	2
3	Determine the 12-hour zero drift, sample 0, Span 1 and Span 2; adjustments may be made to the instrument, if necessary, after readings are taken.	105	30	3
4	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	125	20	4
5	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	105	20	5
6	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2; instrument adjustments permitted after readings are taken.	125	30	6
7	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2[b]	105	30	7
8	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	125	20	8
9	Determine the 12-hour zero drift; sample 0, Span 1, Span 2; adjustments permitted after readings are taken.	105	20	9
10	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	125	30	10
11	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	105	30	11
12	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2; adjustments permitted after readings are taken.	125	20	12
13	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	105	20	13
14	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	125	30	14
15	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2; End of test	-	-	15

[a] These tests shall be run only once each day. Tests shall also be run either on consecutive days with adjustments permitted every three days or in increments of three consecutive days during which adjustments to the instrument are not permitted. In the afternoon, other tests not requiring adjustments to the instrument may be performed, i.e., for rise time, fall time, lag time and precision.

[b] At this time examine test results to determine if further tests are required.

[c] Voltage specified shall be controlled to ± 1 volt.

[d] Temperature specified shall be controlled to ± 2°C.

[e] Sample zero air continuously for a minimum of 12-hours.

TABLE X

EVALUATION OF SUBPART C FOR OXIDANT METHODS: MANUAL KI VS BENDIX ANALYZER - PHASE I

TEST PERIOD	INPUT O_3 LEVEL	OUTPUT-ppm O_3 REFERENCE[(a)]	BENDIX[(b)]	DIFF. (a)-(b) PPM O_3	TOLERANCE PPM O_3	PASSED/ FAILED
DAY 1	LOW	0.090	0.088	-0.002	±0.02	PASSED
	MED	0.22	0.23	+0.01	±0.03	PASSED
	HIGH	0.41	0.40	0.0	±0.04	PASSED
DAY 2	LOW	0.069	0.071	+0.002	±0.02	PASSED
	MED	0.21	0.22	+0.01	±0.03	PASSED
	HIGH	0.40	0.40	0.0	±0.04	PASSED
DAY 3	LOW	0.082	0.087	+0.005	±0.02	PASSED
	MED	0.23	0.24	+0.01	±0.03	PASSED
	HIGH	0.38	0	+0.02	±0.04	PASSED
DAY 4	LOW	0.077	0.082	+0.005	±0.02	PASSED
	MED	0.21	0.21	0.0	±0.03	PASSED
	HIGH	0.41	0.42	+0.01	±0.04	PASSED
DAY 5	LOW	0.066	0.065	-0.001	±0.02	PASSED
	MED	---	---	---	±0.03	---
	HIGH	0.38	0.40	+0.02	±0.04	---

NOTE: (a) = Manual KI method, (b) = Bendix O_3 Monitor

TABLE XI

EVALUATION OF SUBPART C FOR SULFUR DIOXIDE METHODS: p-ROSANILINE MANUAL METHOD VS MELPAR ANALYZER - PHASE II

TEST PERIOD	INPUT SO_2 LEVEL	OUTPUT-ppm SO_2		DIFF.	TOLERANCE	PASSED/ FAILED
		REFERENCE[a]	MELPAR[b]	(a)-(b) PPM SO_2	PPM SO_2	
DAY 1	HIGH	0.37	0.40	+0.03	±0.04	PASSED
2	LOW	0.027	0.03	+0.003	±0.02	PASSED
3	MED	0.11	0.14	+0.03	±0.03	PASSED
4	HIGH	0.39	0.43	+0.04	±0.04	PASSED
5	MED	0.14	0.15	+0.01	±0.03	PASSED
6	LOW	0.04	0.04	0.0	±0.02	PASSED
7	HIGH	0.41	0.64	+0.23	±0.04	FAILED
DAY 1	HIGH	0.35	0.41	+0.06	±0.04	FAILED
1	HIGH	0.37	0.44	+0.07	±0.04	FAILED
1	HIGH	0.37	0.43	+0.06	±0.04	FAILED
4	HIGH	0.39	0.43	+0.04	±0.04	PASSED
4	HIGH	0.39	0.43	+0.04	±0.04	PASSED
7	HIGH	0.42	0.66	+0.24	±0.04	FAILED
7	HIGH	0.41	0.68	+0.27	±0.04	FAILED

NOTE: (a) Manual p-rosaniline, (b) Melpar Analyzer

TABLE XII

EVALUATION OF SUBPART C FOR SULFUR DIOXIDE METHODS: MANUAL p-ROSANLINE METHOD VS TECHNICON ANALYZER - PHASE II

TEST PERIOD	INPUT SO_2 LEVEL	OUTPUT-ppm SO_2 REFERENCE(a)	TECHNICON(b)	DIFF. (a)-(b) PPM SO_2	TOLERANCE PPM SO_2	PASSED/ FAILED
DAY 1	HIGH	0.37	0.40	+0.03	±0.04	PASSED
2	LOW	0.0	0.051	-0.024	±0.02	PASSED
3	MED	0.11	0.14	0.03	±0.03	PASSED
4	HIGH	0.39	0.39	0.0	±0.04	PASSED
5	MED	0.14	0.12	-0.02	±0.03	PASSED
6	LOW	0.041	0.032	-0.009	±0.02	PASSED
7	HIGH	0.41	0.44	+0.03	±0.04	PASSED
DAY 1	HIGH	0.35	0.39	+0.04	±0.04	PASSED
1	HIGH	0.37	0.40	+0.03	±0.04	PASSED
1	HIGH	0.37	0.40	+0.03	±0.04	PASSED
4	HIGH	0.37	0.40	+0.03	±0.04	PASSED
4	HIGH	0.37	0.40	+0.03	±0.04	PASSED
7	HIGH	0.42	-.42	0.0	±0.04	PASSED
7	HIGH	0.41	0.44	+0.03	±0.04	PASSED

NOTE: (a) Manual p-rosaniline method, (b) Technicon Air Monitor

TABLE XIII

Times to Conduct Test Procedures in Subpart B for Performance

Task or Procedure	Time in Man-Hours		
	Technicon	Melpar	Bendix
1. Prepare and calibrate test analyzers	80	64	16
2. Noise, at 0%[(a)]	21	14	14
3. at 80%[(a)]	28	28	14
4. Lower Detectable Limit[(a)]	56	28	18
5. Zero Drift	98[(b)]	98[(b)]	98[(b)]
6. Span Drift, at 20%	28	28	18
7. , at 80%	28	28	18
Subtotal	241	190	98
8. Lag Time	7	4	4
9. Rise Time	28	7	7
10. Fall Time	28	7	7
Subtotal	63	18	18
11. Precision, at 20%	224	11	11
12. , at 80%	224	11	11
Subtotal	448	22	22
13. Interference Equivalent[(a)]			
HCl	140	-	-
NH_3	140	-	-
H_2S	140	84	84
NO_2	84	-	84
CO_2	84	-	84
O_3	112	-	-

TABLE XIII (con't)

Times to Conduct Test Procedures in Subpart B for Performance

Task or Procedure	Time in Man-Hours		
	Technicon	Melpar	Bendix
H_2O	-	84	-
CO	-	84	112
Subtotal	700	252	364
14. Total Man-Hours (1st test set)	1452	482	502
15. Net Man-Hours (14 - 8, 9, 10)	1389	464	484
16. Conduct 2nd test set	1496(c)	457(c)	535(c)

(a) Time for seven trials extrapolated from results of one trial.

(b) Unattended operation; data not included in totals.

(c) Net Man-Hours less Item 1.

TABLE XIV

Times to Conduct Test Procedure in Subpart C for Consistent Relationship

Task	Time in Man-Hours		
	SO_2	O_3	CO[a]
1. Design, construct and install sampling probe and distribution manifold	80	80	80
2. Prepare and calibrate reference and candidate methods or analyzers	80	40	40
3. Conduct initial test set and reduce data.	64	64	64
Subtotal (2 + 3)	154	104	104
4. Conduct second test set and reduce data.	72	72	72
Total	306	256	256

[a] Values extrapolated from evaluation of procedure for oxidant (O_3) methods.

TABLE XV

Overall Times to Determine Equivalency

Task	Time in Man-Hours Technicon	 Melpar	 Bendix
1. Design, fabricate and install gas generation system	176	176	176
2. Design, fabricate and install sampling probe and manifold.	80	80	80
3. Conduct initial test set			
(a) Performance	1389	464	484
(b) Consistent Relationship	154	104	104
Subtotal	1543	568	588
4. Conduct second test set			
(a) Performance	1496	457	535
(b) Consistent Relationship	72	72	72
Subtotal	1568	529	607
5. Total (3 + 4)	3111	1197	1195

Figure 1: GAS GENERATION SYSTEM

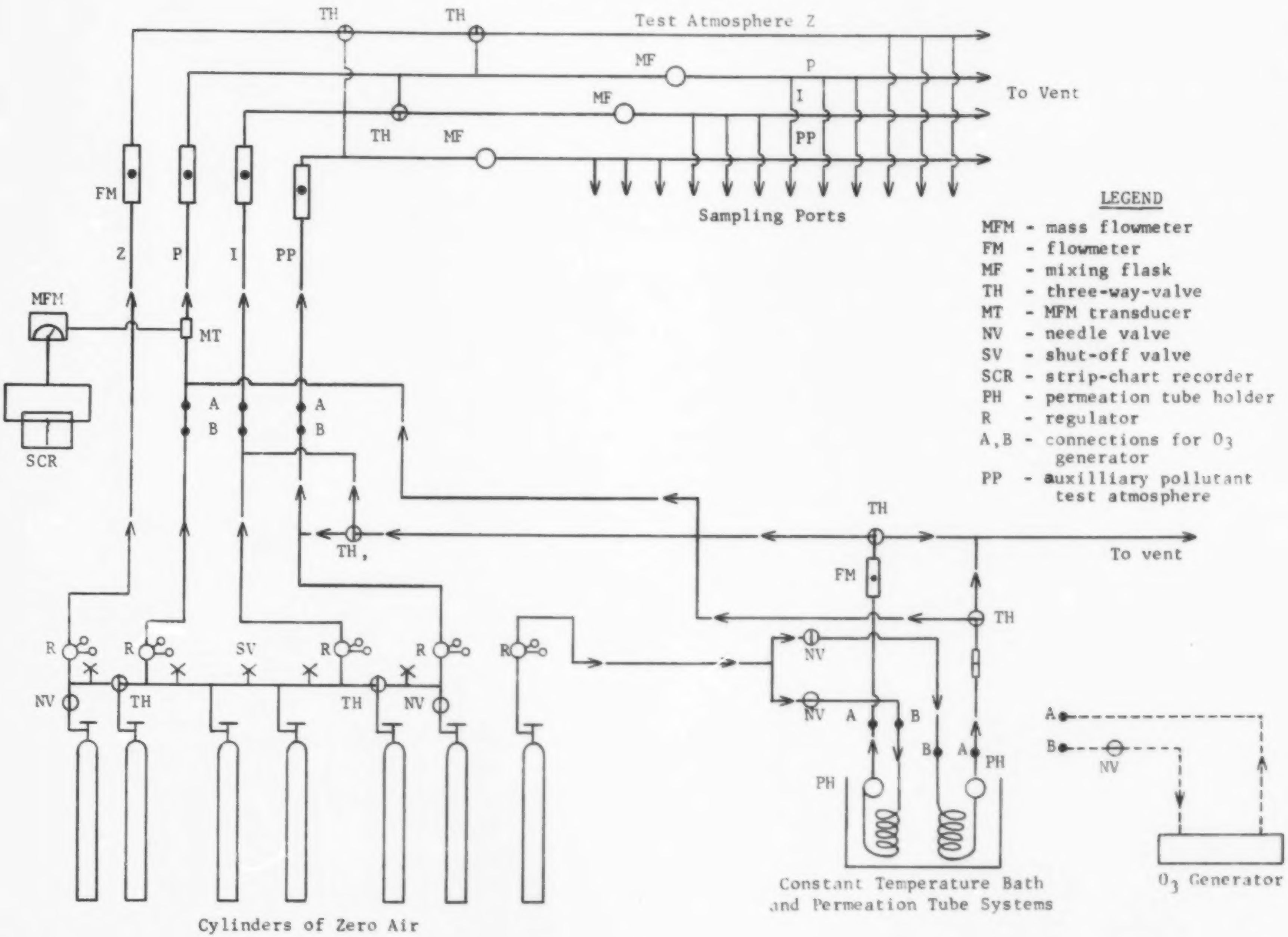
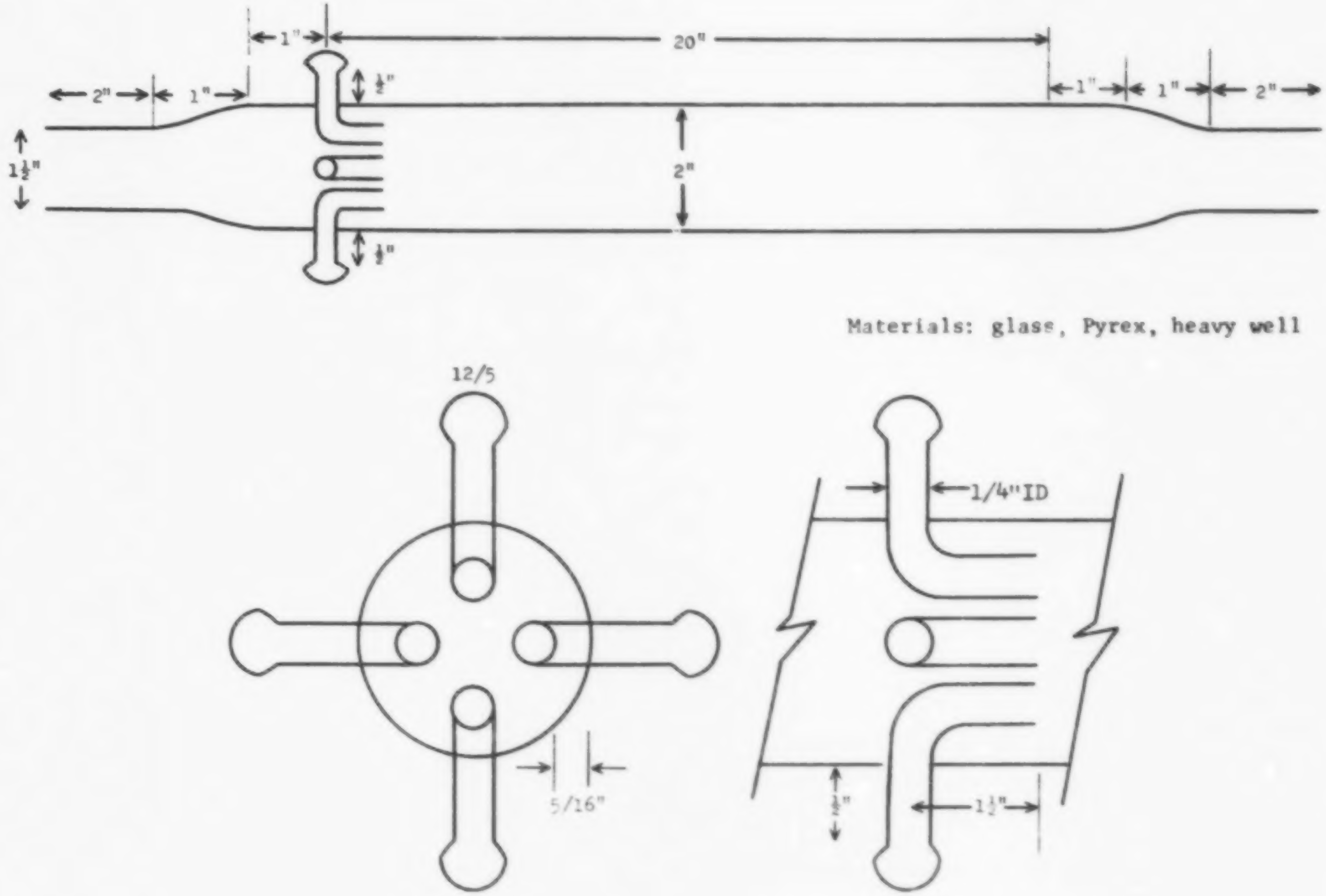

Test Atmosphere Z
TH
TH
TH
TH
MF
MF
MF
P
I
PP
To Vent
Sampling Ports
FM
Z
P
I
PP
MFM
MT
SCR
A
B
A
B
TH,
TH
FM
TH
To vent
R
SV
NV
TH
NV
Cylinders of Zero Air
PH
PH
Constant Temperature Bath
and Permeation Tube Systems
A
B
NV
O_3 Generator
LEGEND
MFM - mass flowmeter
FM - flowmeter
MF - mixing flask
TH - three-way-valve
MT - MFM transducer
NV - needle valve
SV - shut-off valve
SCR - strip-chart recorder
PH - permeation tube holder
R - regulator
A,B - connections for O_3 generator
PP - auxilliary pollutant test atmosphere

Figure 2: Gas Sampling Manifold


1"
20"
2"
1"
2"
½"
1½"
2"
½"
1"
1"
2"
12/5
1/4"ID
5/16"
½"
1½"

Materials: glass, Pyrex, heavy well

FIG. 3: Dynamic Calibration Curve of the Technicon Air Monitor IV for SO_2

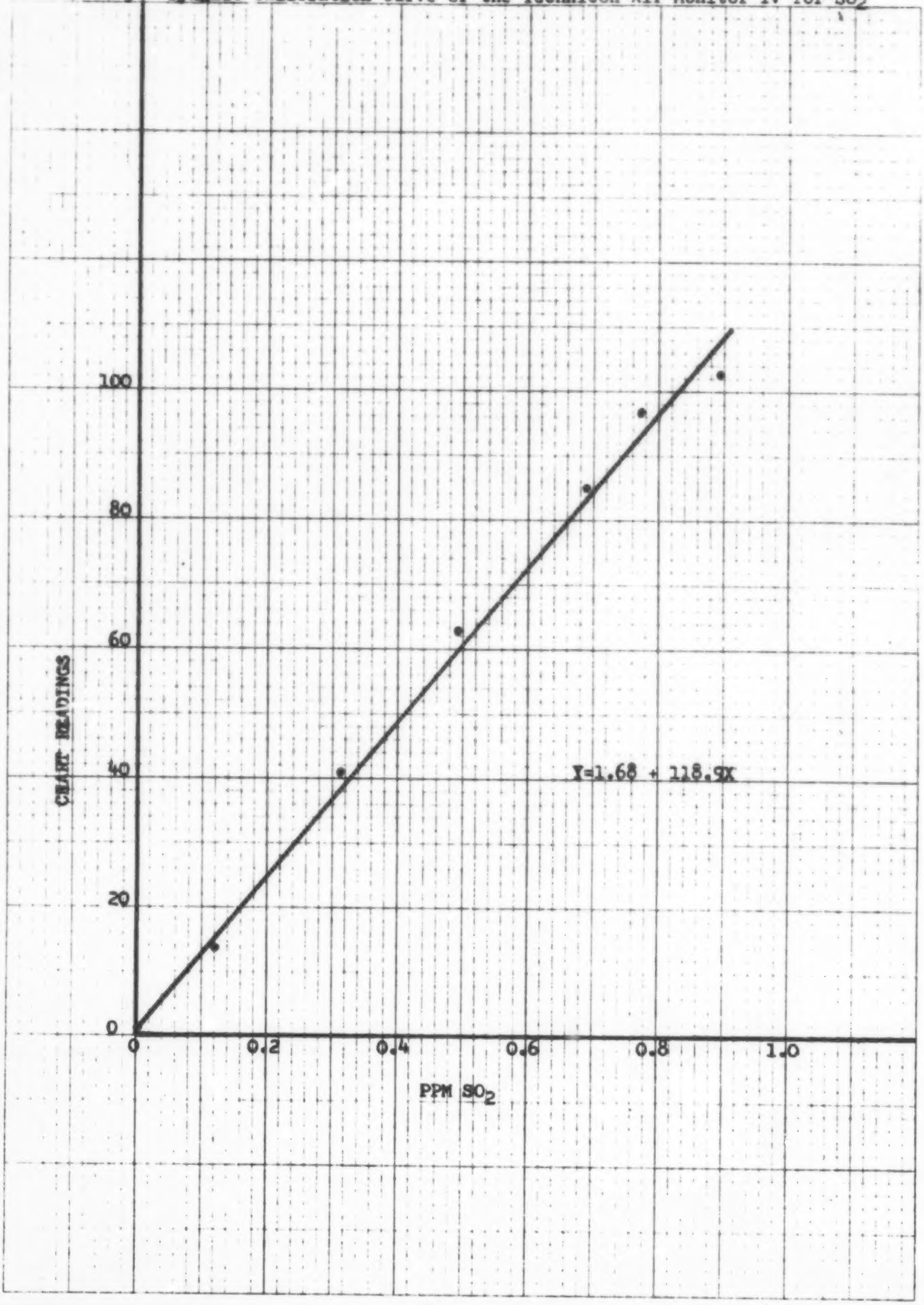


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FIG. 4: Dynamic Calibration Curve for the Melpar Total Sulfur Analyzer, Model LL-1100-1B

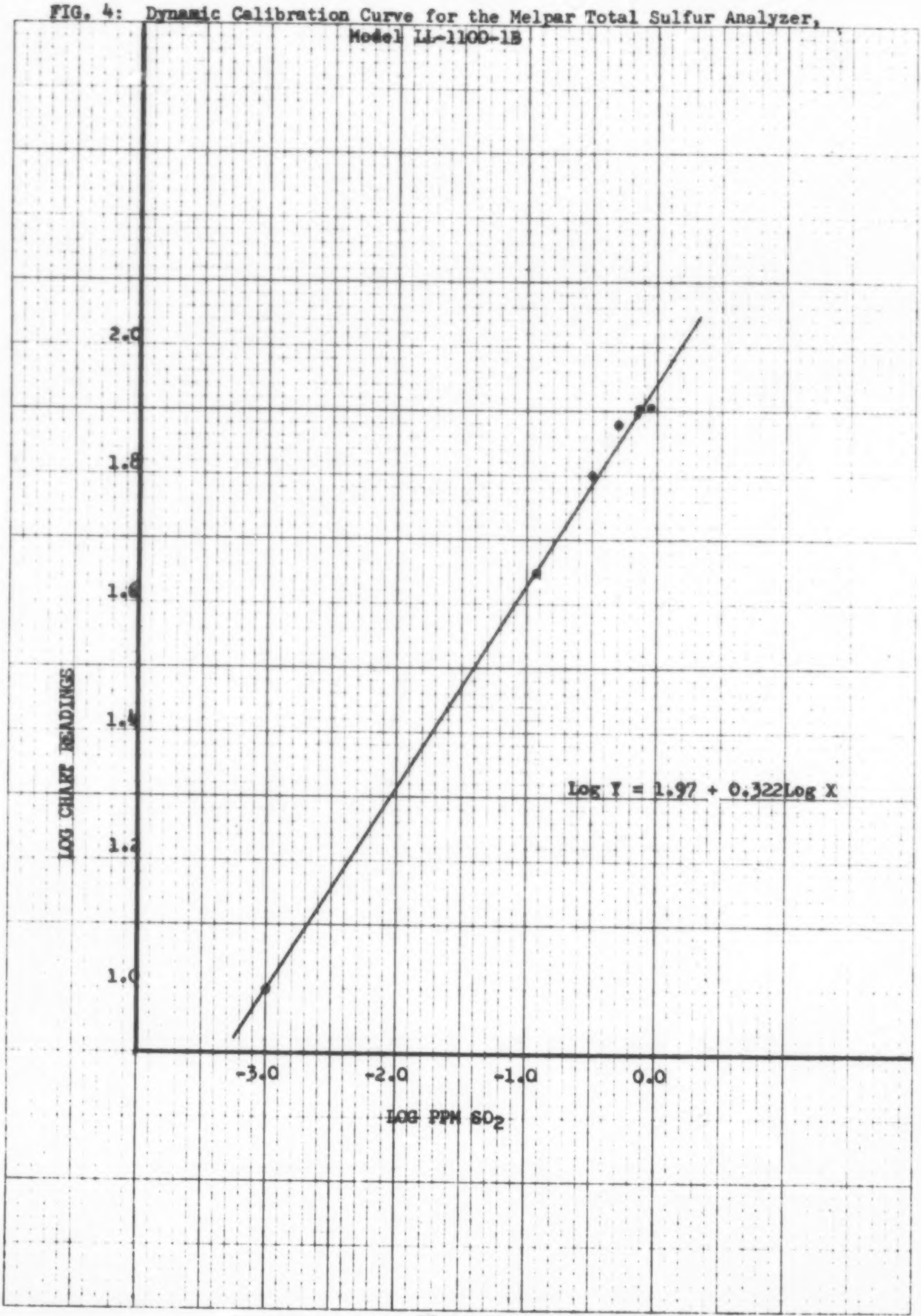

FIG. 5: Calibration Curve for the Melpar Total Sulfur Analyzer, Model LL-1100-1B

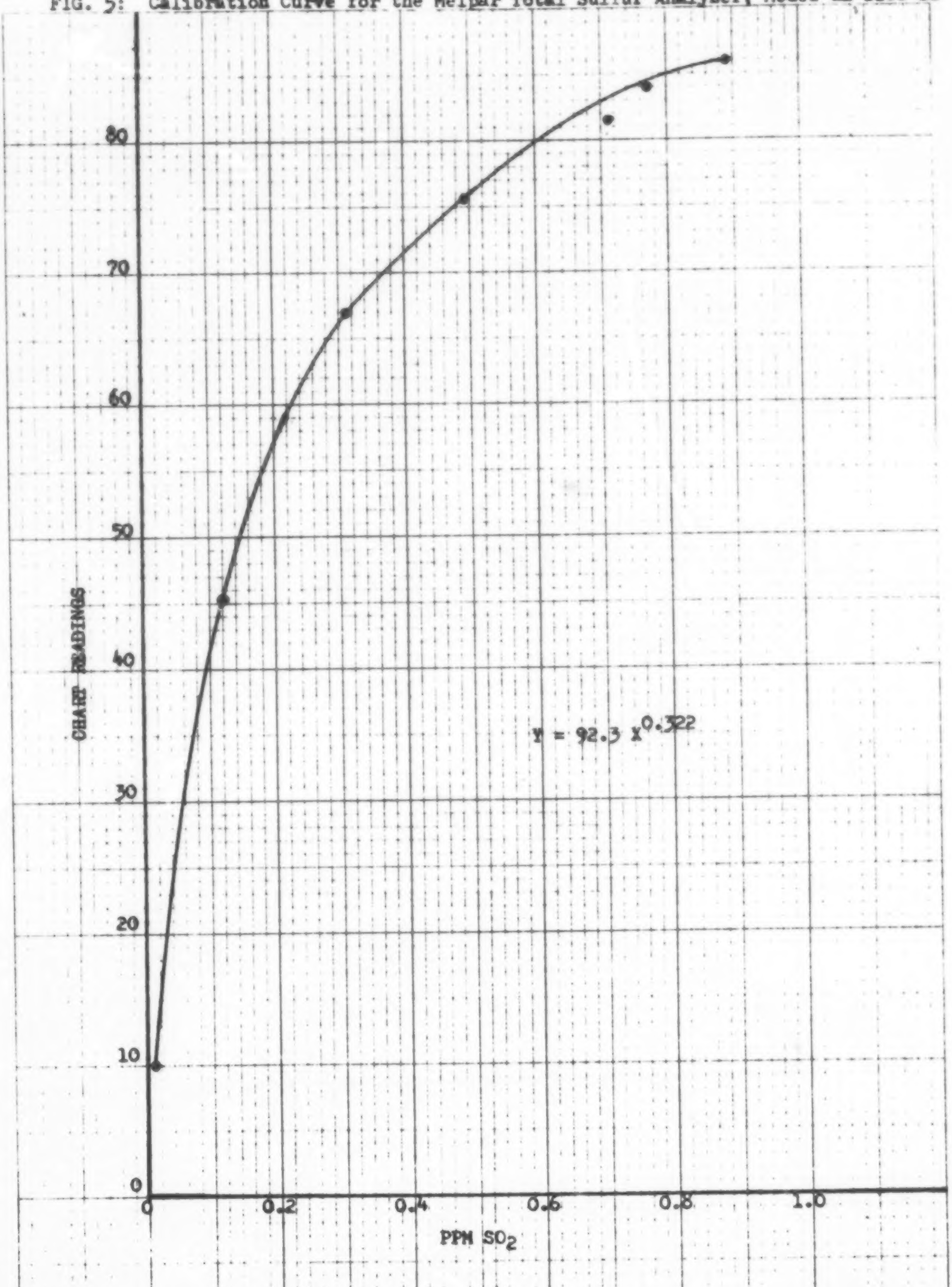

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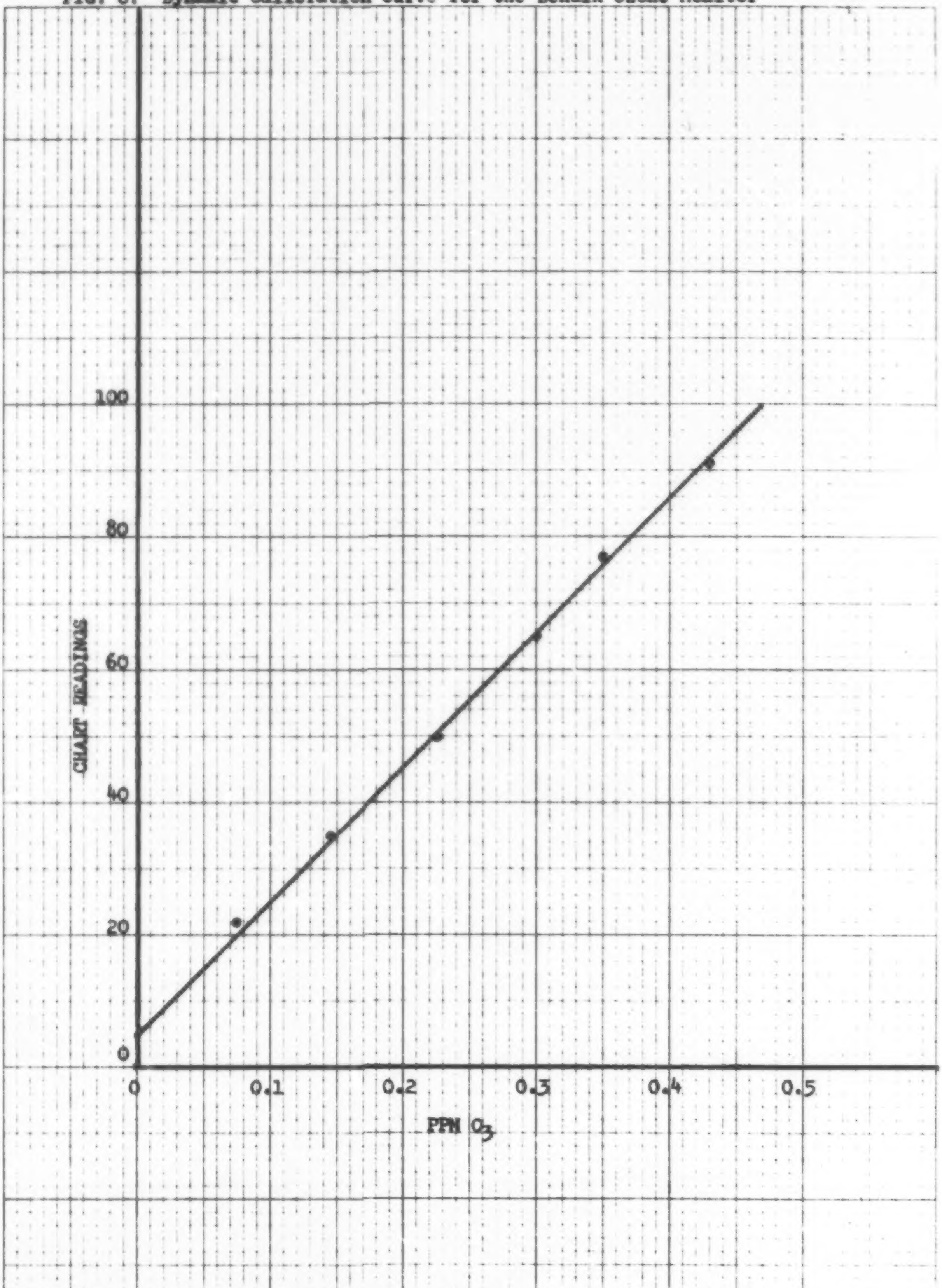
FIG. 6: Dynamic Calibration Curve for the Bendix Ozone Monitor



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PART II

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ENVIRONMENTAL PROTECTION AGENCY

■

AMBIENT AIR MONITORING EQUIVALENT AND REFERENCE METHODS

ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Parts 50, 51]

AMBIENT AIR MONITORING EQUIVALENT AND REFERENCE METHODS

Notice of Proposed Rulemaking

Notice is hereby given that the Environmental Protection Agency is considering amendments to Parts 50 and 51 of Title 40, Code of Federal Regulations, as set forth below.

Elsewhere in this issue of the FEDERAL REGISTER, EPA is proposing the addition of a new Part 53, entitled "Ambient Air Monitoring Equivalent and Reference Methods," to Title 40 of the Code of Federal Regulations. As more fully described in the Notice of Proposed Rulemaking concerning the proposed new Part 53, that Part would establish definitive requirements and precedures applicable to determinations whether methods of sampling and analyzing the ambient air may be designated "equivalent methods" or "reference methods" for the measurement of specified air pollutants. It is intended that such determinations be governed in the future by the provisions of the proposed Part 53 as finally promulgated. The amendments proposed in this Notice would revise existing provisions pertinent to such determinations and would, in effect, provide that for purposes of Parts 50 and 51 such determinations will be governed in the future by the provisions of Part 53.

Interested persons may submit written comments on the proposed amendments in triplicate to the quality Assurance and Environmental Monitoring Laboratory, United States Environmental Protection Agency, National Environmental Research Center, Research Triangle Park, North Carolina 27711. All relevant comments postmarked not later than 45 days after publication of this notice will be considered. All comments will be available for public inspection during normal business hours at the address specified above.

This notice of proposed rulemaking is issued under the authority of sections 109 and 301(a) of the Clean Air Act, as amended (42 U.S.C. 1857c-4, 1857g(a)).

Dated September 26, 1973.

JOHN QUARLES,
Acting Administrator,
Environmental Protection Agency.

Part 50 of Title 40 of the Code of Federal Regulations is proposed to be amended as follows:

In § 50.1, paragraphs (f) and (g) are revised to read as follows:

§ 50.1 Definitions.

* * * * *

(f) "Reference method" means a method of sampling and analyzing the ambient air for an air pollutant as described in an appendix to this part or a method that has been designated as a reference method in accordance with part 53 of this chapter.

(g) "Equivalent method" means any method of sampling and analyzing the ambient air for an air pollutant that has been designated as an equivalent method in accordance with part 53 of this chapter.

Part 51 of Title 40 of the Code of Federal Regulations is proposed to be amended as follows:

1. In § 51.14, the table in subparagraph (1) of paragraph (e) is revised by revising footnote 1 to read as follows:

§ 51.14 Control Strategy: Carbon monoxide, hydrocarbons, photochemical oxidants, and nitrogen dioxide.

* * * * *

(e) * * *

(1) * * *

1. Other methods of measurement will be considered equivalent methods if they have been designated equivalent methods in accordance with part 53 of this chapter.

2. In § 51.17, the table in subparagraph (1) of paragraph (a) is revised by revoking footnotes d, e, and f, by revoking the table of performance specifications for pollutants sulfur dioxide, carbon monoxide and photochemical oxidant (corrected for NO_2 and SO_2) appearing after the colon in the second sentence of footnote 1, and by revising the second sentenec of footnote 1 to read as follows:

§ 51.17 Air quality surveillance.

(a) (1) * * *

* * * * *

1 * * * Other methods of measurement will be considered equivalent methods if they have been designated equivalent methods in accordance with part 53 of this chapter.

* * * * *

[FR Doc.73-21338 Filed 10-11-73;8:45 am]

[40 CFR Part 53]

AMBIENT AIR MONITORING EQUIVALENT AND REFERENCE METHODS

Notice of Proposed Rulemaking

Notice is hereby given that the Environmental Protection Agency is considering the addition of a new Part 53 to Title 40 of the Code of Federal Regulations, as set forth below. The proposed new Part 53 would establish requirements and procedures applicable to determinations whether, for purposes described more fully below, methods of sampling and analyzing the ambient air may be designated "equivalent methods" or "reference methods" for the measurement of specified air pollutants.

As required by section 109 of the Clean Air Act, as amended December 31, 1970 (Public Law 91-604), the Administrator of the Environmental Protection Agency published on January 30, 1971 (36 FR 1502) and March 30, 1971 ((36 FR 5867)), proposed national primary and secondary ambient air quality standards for six pollutants and, after consideration of comments received, promulgated the same on April 30, 1971, 36 FR 8186. The national ambient air quality standards are now codified at 40 CFR Part 50. In addition to prescribing ambient air quality standards, the Administrator published certain test procedures to be utilized by the Environmental Protection Agency and State and local agencies to measure the levels of ambient air quality for each of the six pollutants. The measurement procedures are described in detail in appendices to Part 50 and are defined in 40 CFR 50.1(f) as "reference methods."

The ambient air quality standards, as prescribed, provide that measurements are to be made by the appropriate reference method or by an "equivalent method." "Equivalent method" is defined in 40 CFR 50.1(g) as "any method of sampling and analyzing for an air pollutant which can be demonstrated to the Administrator's satisfaction to have a consistent relationship to the reference method." 40 CFR 51.17(a)(1), discussed below, contains additional requirements applicable to a determination that a method is an "equivalent method." In addition to the requirement that a consistent relationship to the reference method be shown, a candidate method is required under § 51.17(a)(1) to meet certain performance specifications described in that section.

Within 9 months after promulgation of the National Ambient Air Quality Standards, i.e., no later than January 30, 1972, each State was required by Section 110 of the Act to adopt and submit to the Administrator a plan which provided for the implementation, maintenance, and enforcement of the national ambient air quality standards within each air quality control region (or portion thereof) within the State. The Act requires the Administrator to approve an implementation plan, or any portion thereof, if he determines that the plan (or portion thereof) was adopted after reasonable notice and hearing and that it satisfies detailed criteria set forth in § 110(a)(2)(A)-(H) of the Act. To assist the States in the development of the implementation plans, and to implement the requirements of § 110, EPA proposed and promulgated regulations entitled "Regulations for Preparation, Adoption, and Submittal of Implementation Plans." See 40 CFR Part 51 (36 FR 15486).

The purpose of the proposed new Part 53 is to assist State and local governments and ambient air monitoring instrument manufacturers with respect to one of the requirements applicable to approval of implementation plans. Section 110(a)(2)(C) of the Act provides in part that a plan must include:

> * * * provision for establishment and operation of appropriate devices, methods, systems, and procedures necessary to (i) monitor, compile, and analyze data on ambient air quality * * *

This provision has been amplified in the implementation plan guidelines at 40 CFR 51.17, "Air Quality Surveillance." Among other things, § 51.17 requires that plans provide for the establishment of an air quality surveillance system as expeditiously as practicable but not later than two years after the date of plan approval. Each surveillance system must comply with certain minimum requirements, one of which is that each method used by a

State to monitor the ambient air be either the appropriate reference method or a method that is equivalent to the reference method. The proposed new Part 53 would establish definitive requirements and procedures by which States or instrument manufacturers may have their monitoring methods determined to be equivalent methods or reference methods.

As indicated previously, 40 CFR 50.1(g) and 51.17(a)(1) presently contain provisions pertinent to determinations whether monitoring methods are equivalent methods, and 40 CFR 50.1(f) defines specified methods as reference methods. In addition, equivalent methods are referred to in 40 CFR 51.14(e)(1). It is intended that determinations whether candidate methods are equivalent methods or reference methods be governed in the future by the provisions of Part 53 as finally promulgated. Accordingly, EPA is proposing elsewhere in this issue of the FEDERAL REGISTER appropriate amendments to 40 CFR 50.1(f), 50.1(g), 51.14(e)(1), and 51.17(a)(1).

It is recognized that some State or local governments may have purchased monitoring instruments or systems that purport to be reference methods or equivalent methods (or elements thereof) in accordance with the existing provisions of 40 CFR 50.1(f), 50.1(g), and 51.17(a)(1) but which will not conform to the requirements of Part 53 if it is promulgated as proposed. Because purchase of such equipment may have been relatively costly, EPA is considering allowing its use on some basis for purposes of 40 CFR 51.17(a)(1), provided that the equipment was purchased prior to publication of this notice in the FEDERAL REGISTER. For example, use of such equipment might be permitted, on a showing satisfactory to the Administrator that the equipment meets the pertinent existing requirements of 40 CFR 50.1(f), 50.1(g), and 51.17(a)(1), for a period that would allow a reasonable time for replacement of the equipment with new equipment satisfying the requirements of Part 53 as finally promulgated. State and local governments and other interested parties are specifically invited to comment on this proposal, to suggest other courses of action that EPA might follow in this regard, and to submit any information that they consider pertinent to the proposal or to alternative courses of action. In particular, State or local governments that have purchased instruments or systems purporting to be reference methods or equivalent methods (or elements thereof) in accordance with 40 CFR 50.1(f), 50.1(g), and 51.17(a)(1) are invited to comment on the number, type, and cost of the instruments or systems they have purchased, the possibility that such equipment might conform to the requirements of the proposed Part 53 if it is promulgated as proposed, and the possibility that nonconforming equipment might be replaced with conforming equipment in time to permit compliance with 40 CFR 51.17(a)(1) within the time specified in that section.

The proposed new Part 53 is divided into three subparts, the contents of which may be summarized as follows.

Subpart A contains the general requirements to be satisfied for an equivalent or reference method determination for both automated and manual methods. It specifies the descriptive information and affidavits that must be submitted whenever such a determination is requested. The primary responsibility for an equivalent or reference method determination rests with the applicant. Candidate automated methods that purport to measure sulfur dioxide, carbon monoxide, or photochemical oxidants must satisfy the performance specifications described in Subpart B and demonstrate a consistent relationship as required by Subpart C. Candidate manual methods need only demonstrate a consistent relationship as required by Subpart C.

Subpart A also provides that any method determined to be an equivalent or reference method will be officially designated as such in the FEDERAL REGISTER. Any applicant whose method is rejected may appeal the rejection by requesting reconsideration. Designations of methods may be cancelled if the methods are subsequently found not to be in compliance with the provisions of Part 53. Prior to cancellation, the manufacturer of the method in question will receive written notice of the facts that the Administrator believes warrant cancellation and an opportunity to demonstrate or come into compliance. In addition, a hearing may be granted. The above procedures will assist the Agency in obtaining reliable data and in making fair and sound judgments when granting, rejecting, or canceling a method.

Subpart B of the proposed Part 53 specifies performance characteristics that must be met by automated methods with respect to interference, lower detectable limit, precision, rise time, fall time, zero drift, span drift, lag time, and noise.

Subpart C contains the general provisions and test procedures necessary for demonstrating a consistent relationship between candidate methods, whether automated or manual, and reference methods.

EPA recognizes that for carbon monoxide, and photochemical oxidants, each reference method designated in 40 CFR Part 50 is a combination of a reference principle and a calibration procedure and not a single specific method. Therefore, it is possible for various instrument manufacturers to construct different air monitoring equipment based on different adaptations of the same reference measurement principle. If an applicant's candidate automated method utilizes the appropriate reference principle and calibration procedures correctly and his instrument satisfies all the performance characteristics of Subpart B, his method may be determined to be a reference method.

It is the intent of EPA to encourage the advancement of the art of monitoring pollutants in ambient air. If the Administrator becomes convinced that a candidate method has the necessary measurment capability and is superior to the existing reference method, he will consider naming it the reference method. In this manner, EPA intends to keep the best available analytical methodology as the reference method.

Interested persons may submit written comments on the proposed regulations in triplicate to the Quality Assurance and Environmental Monitoring Laboratory, United States Environmental Protection Agency, National Environmental Research Center, Research Triangle Park, North Carolina 27711. All relevant comments postmarked not later than 45 days after publication of this notice will be considered. All comments will be available for public inspection during normal business hours at the address specified above. The regulations, modified as the Administrator deems appropriate after consideration of comments, will be effective on October 12, 1973.

This notice of proposed rulemaking is issued under the authority of section 301(a) of the Clean Air Act, as amended (42 U.S.C. § 1857g(a)).

Dated September 26, 1973.

JOHN QUARLES,
Acting Administrator,
Environmental Protection Agency.

A new Part 53 is added to Chapter I, Title 40, Code of Federal Regulations, as follows:

PART 53—AMBIENT AIR MONITORING EQUIVALENT AND REFERENCE METHODS

Subpart A—General Provisions

Sec.
53.1 Definitions.
53.2 Applicability.
53.3 Request for equivalent or reference method determinations.
53.4 General requirements for an equivalent method determination.
53.5 General requirements for a reference method determination.
53.6 Procedures for equivalent and reference method determinations.
53.7 Right of entry; tests and inspections.
53.8 Publication of equivalent and reference methods.
53.9 Appeal.
53.10 Cancellation of an equivalent or reference method determination.
53.11 Hearings on cancellation.
53.12 Modification of an equivalent method.
53.13 Modification of a reference method.
53.14 Trade secrets and confidential and privileged information.

Subpart B—Test Procedures for Measuring Performance Characteristics

Sec.
53.20 General provisions.
53.21 Test procedures for automated methods.
53.22 Procedures for measuring performance specifications.

Subpart C—Test Procedures for Demonstrating a Consistent Relationship Between Candidate Methods and Reference Methods

Sec.
53.30 General provisions.
53.31 Test procedure for oxidant methods.

Sec.
53.32 Test procedure for carbon monoxide methods.
53.33 Test procedure for sulfur dioxide methods.

AUTHORITY: Sec. 301(a) of the Clean Air Act (42 U.S.C. section 1857g(a)), as amended by sec. 15(c)(2) of Public Law 91-604, 84 Stat. 1713.

Subpart A—General Provisions

§ 53.1 Definitions.

(a) As used in this part, all terms not defined herein shall have the meaning given them by the Act.

(b) "Act" means the Clean Air Act, as amended (42 U.S.C. 1857 *et seq.*).

(c) "Agency" means the Environmental Protection Agency.

(d) "Administrator" means the Administrator of the Environmental Protection Agency or his authorized representative.

(e) "Reference Method" means any method of sampling and analyzing the ambient air for an air pollutant which has been determined in accordance with this part to be in compliance with the criteria described in the appropriate appendix to Part 50 of this chapter, and has been officially designated as a reference method by publication in the FEDERAL REGISTER.

(f) "Equivalent Method" means any method of sampling and analyzing the ambient air for an air pollutant which has been determined in accordance with this part to meet all the requirements of this part, and has been officially designated as an equivalent method by publication in the FEDERAL REGISTER.

(g) "Candidate Method" means any method of sampling and analyzing the ambient air for an air pollutant submitted to the Administrator for an equivalency determination or a reference method determination.

(h) "Automated Method" means an instrumental technique that automatically samples, analyzes, and provides a record of the concentration of an ambient air pollutant in a single measurement system.

(i) "Manual Method" means a method for measuring concentrations of an ambient air pollutant in which the sample collection and analysis are performed in separate systems.

(j) "Applicant" means any person who submits a candidate method to the Administrator for an equivalent or reference method determination.

(k) "Ultimate Purchaser" means the first person who purchases, for purposes other than resale, an ambient air monitoring method which has been determined by the Administrator to be an equivalent or reference method.

§ 53.2 Applicability.

The provisions of this part apply to any applicant who requests a determination that a candidate method is an equivalent method or a reference method.

§ 53.3 Request for equivalent or reference method determinations.

All data and information required shall be submitted in triplicate to:

Director, Quality Assurance and Environmental Monitoring Laboratory
United States Environmental Protection Agency
National Environmental Research Center
Research Triangle Park, North Carolina 27711

§ 53.4 General requirements for an equivalent method determination.

(a) Automated methods: The requirements for performance specifications (Subpart B) and for consistent relationship (Subpart C) shall be satisfied to establish equivalence of automated methods for monitoring sulfur dioxide, carbon monoxide, and photochemical oxidants.

(b) Manual methods: Candidate methods which are manual methods shall satisfy the requirements for consistent relationship as specified in subpart C.

(c) Test data and information required to be submitted:

(1) Data on appropriate performance specifications as defined in § 53.20(d) (Table B–1) which relate to the pollutants which the candidate method is designed to measure shall be submitted. All data for each performance specification shall be acquired by the procedures described in subpart B.

(2) Data on the simultaneous "side-by-side" determinations of pollutant concentrations by the candidate method and the reference method shall be submitted. The test procedures described in subpart C shall be followed.

(d) Descriptive information and sworn statements to be submitted:

(1) A detailed description of the candidate method including but not limited to measurement principle, manufacturer, name, model number, a listing of the components, and schematic diagrams, shall be submitted.

(2) A detailed description of the quality control program utilized to assure that all measurement systems that are or that will be made available have the same performance characteristics as the candidate method tested shall be submitted.

(3) A comprehensive description defining calibration and operational procedures which the manufacturer prescribes for field use of the candidate method shall be submitted.

(4) A statement that the candidate method described in accordance with paragraph (d)(3) and/or paragraph (e) of this section is representative of the measurement systems tested, shall be submitted.

(5) A statement that the candidate method has been tested in accordance with the procedures described in subpart B and/or subpart C, as applicable, shall be submitted.

(e) Operation manual: A manual which fully describes how a candidate method and the instruments utilized as part of that method should be operated, shall be submitted. This manual may be utilized to satisfy the requirements of paragraphs (d) (1) and (3) of this section. Any manual which does not provide the information and data required by paragraphs (d) (1) and (3) of this section shall be supplemented as necessary. Candidate methods determined to be equivalent methods shall be accompanied by such manual when delivered to the ultimate purchaser.

(f) Durability of automated methods:

(1) Approved automated methods shall function within the limits of the performance specifications listed at § 53.20 (d) for at least one year after installation in the field, when properly maintained and operated.

(2) If the Administrator determines that a representative sample of a manufacturer's approved automated method fails to perform as required by paragraph (f)(1) of this section, such manufacturer's equivalency determination shall be cancelled in accordance with § 53.10 of this part.

§ 53.5 General requirements for a reference method determination.

(a) Utilization of the reference principle and calibration procedures: All candidate methods submitted for a reference method determination shall utilize the appropriate reference principle and calibration procedures as described in the appendices to part 50 of this chapter.

(b) Automated methods: All candidate automated methods shall comply with the requirements of subpart B of this part.

(c) Descriptive information and sworn statements to be submitted:

(1) A detailed description of the candidate method including measurement principle, manufacturer, name, model number and other forms of identification, including but not limited to a listing of the components and schematic diagrams, shall be submitted.

(2) A detailed description of the quality control program utilized to assure that all measurement systems that are or will be made available have the same performance characteristics as the candidate method tested, shall be submitted.

(3) A comprehensive description defining the calibration and testing procedures which have been followed for the candidate method, shall be submitted.

(4) A statement that the candidate method described in accordance with paragraph (c)(1) of this section is representative of the measurement system tested, shall be submitted.

(5) A statement that the candidate method has been tested in accordance with the procedures described in subpart B of these regulations and Part 50 of this chapter, shall be submitted.

(d) Operation manual. A manual which describes how a candidate method and the instruments utilized as part of that method should be operated shall be submitted. This manual may be utilized to satisfy the requirements of paragraphs (c) (1) and (3) of this section. Any manual which does not provide the information and data required by paragraphs (c) (1) and (3) shall be supplemented as necessary. Candidate methods determined to be reference methods shall be accompanied by such manual when delivered to the ultimate purchaser.

(e) Durability of automated reference methods:

(1) Approved automated methods shall function within the limits of the

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performance specifications listed at § 53.20(d) for at least one year after installation in the field, when properly maintained and operated.

(2) If the Administrator determines that a representative sample of a manufacturer's approved automated method fails to perform as required by paragraph (e)(1) of this section, such manufacturer's reference method determination shall be canceled in accordance with § 53.10.

§ 53.6 Procedures for equivalent and reference method determinations.

Upon receipt of the data and information specified in this part, the Administrator will review the submission and, within 60 calendar days, take one or more of the following actions:

(a) Notify the applicant that his method has been determined to be an equivalent or reference method;

(b) Notify the applicant that his request for an equivalent or reference method determination has been rejected, including a statement of reasons for rejection;

(c) Notify the applicant that his submission is incomplete and request the additional information that is needed (incomplete submissions will not start the 60-day period that will be utilized by the Administrator to determine if the candidate method is an equivalent or reference method);

(d) Notify the applicant that additional tests will be conducted by the Administrator, specifying the reasons for the additional tests (the 60-day period will commence one calendar day after the additional tests have been completed).

§ 53.7 Right of entry; tests and inspections.

Any request for an equivalent or reference method determination shall constitute consent for the Administrator or his authorized representative, upon presentation of appropriate credentials, to enter at reasonable times any premise, used to construct, modify, operate or test the applicant's instrument(s) for which an equivalent or reference method determination is sought, for the purpose of making inspections and conducting tests to assist in making equivalent or reference method determinations, and to determine compliance with this part.

§ 53.8 Publication of equivalent and reference methods.

Candidate methods which satisfy the criteria of this part will be designated as equivalent or reference methods and such determination will be published in the FEDERAL REGISTER not later than 60 days after the completed submission, or if additional tests have been conducted pursuant to § 53.6(d), 60 calendar days after the completion of such tests.

§ 53.9 Appeal.

Any applicant whose request for an equivalent or reference method determination has been rejected, may appeal the Administrator's decision as follows: (a) The applicant may submit another request for the appropriate determination, (b) the applicant may request the Administrator to reconsider the data and information already submitted, (c) the applicant may request that the Administrator repeat any test which he conducted that was a material factor in his decision to reject the method. A representative of the manufacturer may be present during the performance of any such retest.

§ 53.10 Cancellation of an equivalent or reference method determination.

If the Administrator makes a preliminary finding on the basis of evidence and data available to him that a representative sample of a method designated as an equivalent or reference method does not fully satisfy the requirements of this part, he shall cancel his determination for that method in accordance with the following procedures.

(a) *Notification and opportunity to make necessary adjustments.* (1) The manufacturer shall be notified in writing of the evidence and data which the Administrator has found to warrant cancellation.

(2) Within 60 days following receipt of notification, the manufacturer shall demonstrate to the Administrator's satisfaction that the method in question satisfies the requirements of this part or commence making the adjustments necessary to bring the method into compliance. If adjustments are required, all instruments (methods) needing the adjustments shall be adjusted within a reasonable time, as determined by the Administrator.

(b) *Request for a hearing.* Within 60 days following receipt of the notification, the manufacturer may request a hearing on the Administrator's preliminary finding. The request shall be in writing, signed by an authorized representative of the manufacturer, and shall include a statement specifying the manufacturer's objections to the Administrator's finding, and data in support of such objections. If, after a review of the request and supporting data, the Administrator finds that the request raises a substantial factual issue, he shall provide the manufacturer a hearing in accordance with § 53.11 with respect to such issue.

(c) *Publication of cancellation.* If, at the end of the 60-day period the Administrator determines that the approval of the method should be canceled, he shall publish a notice of cancellation in the FEDERAL REGISTER. If a hearing has been requested and granted in accordance with § 53.10, a cancellation notice will not be published until the hearing proceedings have been completed including any administrative review and unless the Agency's determination to cancel has been sustained by the Administrator.

§ 53.11 Hearings on cancellation.

(a)(1) After granting a request for hearing under § 53.10, the Administrator will designate a presiding officer for the hearing.

(2) The General Counsel or his representative will represent the Environmental Protection Agency in any hearing under this section.

(3) If a time and place for the hearing have not been fixed by the Administrator pursuant to § 53.10, the hearing shall be held as soon as practicable at a time and place fixed by the Administrator or by the presiding officer.

(b)(1) Upon his appointment pursuant to paragraph (a) of this section, the Presiding Officer will establish a hearing file. The file shall consist of the notice issued by the Administrator under § 53.10, together with any accompanying material, the request for a hearing and the supporting data submitted therewith and correspondence and other material data relevant to the hearing.

(2) The hearing file will be available for inspection by the manufatcurer or its representative at the office of the Presiding Officer.

(c) The manufacturer of the method in question may be represented by counsel or by any other duly authorized representative.

(d)(1) The Presiding Officer upon the request of any party, or in his discretion, may arrange for a prehearing conference at a time and place specified by him to consider the following:

(i) Simplification of the issues;

(ii) Stipulations, admissions of fact and the introduction of documents;

(iii) Limitation of the number of expert witnesses;

(iv) Possibility of agreement disposing of all or any of the issues in dispute;

(v) Such other matters as may aid in the disposition of the hearing, including such additional tests as may be agreed upon by the parties.

(2) The results of the conference shall be reduced to writing by the Presiding Officer and made part of the record.

(e)(1) Hearings shall be conducted by the Presiding Officer in an informal but orderly and expeditious manner. The parties may offer oral or written evidence, subject to exclusion by the Presiding Officer of irrelevant, immaterial, or repetitious evidence.

(2) Witnesses shall be placed under oath.

(3) Any witness may be examined or cross-examined by the Presiding Officer, the parties or their representatives. The Presiding Officer may, in his discretion, limit cross-examination to relevant and material issues.

(4) Hearings shall be reported verbatim. Copies of transcripts of proceedings may be purchased by the manufacturer from the reporter.

(5) All written statements, charts, tabulations, and data offered in evidence at the hearing shall, upon a showing satisfactory to the Presiding Officer of their authenticity, relevancy, and materiality, be received in evidence and shall constitute part of the record.

(6) Oral argument shall be permitted. The Presiding Officer may limit oral presentations to relevant and material

issues and designate the amount of time allowed for oral argument.

(f)(1) The Presiding Officer shall make an initial decision which shall include written findings and conclusions and the reasons therefor on all the material issues of fact, law, or discretion presented on the record. The findings, conclusions, and written decision shall be provided to the parties and made part of the record. The initial decision shall become the decision of the Administrator without further proceedings unless there is an appeal to the Administrator or motion for review by the Administrator within 20 calendar days of the date the initial decision was filed.

(2) On appeal from or review of the initial decision the Administrator shall have all the powers which he would have in making the initial decision including the discretion to require or allow briefs, oral argument, the taking of additional evidence or the remanding to the Presiding Officer for additional proceedings. The decision by the Administrator shall include written findings and conclusions and the reasons or basis therefor on all the material issues of fact, law, or discretion presented on the appeal or considered in the review.

§ 53.12 Modification of an equivalent method.

After a method has been designated equivalent, any modification made to the method, including but not limited to design, construction, and operational and maintenance procedures shall be reported to the Administrator within 15 calendar days of such modification. If the Administrator makes a preliminary finding that, as modified, the method does not satisfy the requirements of this part, he will notify the applicant, within 30 calendar days from date of the report of his intention to cancel the designation in accordance with § 53.10. If the Administrator determines that additional tests are needed to enable him to determine whether to continue the designation in effect, he shall so notify the applicant within 15 calendar days of the report.

§ 53.13 Modification of a reference method.

After a candidate method has been designated a reference method (automated or manual), any modification to the method, including but not limited to, design and construction, and operational and maintenance procedures shall be reported to the Administrator within 15 calendar days of such modification. Any modification of the construction or design of the method shall be cause for cancellation of the Administrator's designation in accordance with § 53.10. Any modification of the operational and maintenance procedures may be cause for cancellation of the Administrator's designation in accordance with § 53.10.

§ 53.14 Trade secrets and confidential and privileged information.

Any information submitted by an applicant for which a claim of trade secrecy and or confidential and privileged status is made shall be clearly identified. Any information for which such a claim is made will be handled in accordance with the Agency's regulations on Public Information, which appear at Part 2 of this chapter.

Subpart B—Test Procedures for Measuring Performance Characteristics

§ 53.20 General provisions.

(a) Test procedures applicable to candidate methods and reference methods which are automated methods for developing observations on Interference, Lower Detectable Limit, Precision, Rise Time, Fall Time, Zero Drift, Span Drift, Lag Time, and Noise are described in this subpart. Measurement systems must be operated in the range specified in Table B-1 of paragraph (d) of this section during conduct of these tests.

(b) All recorder chart tracings, test data and other documentation obtained for the purpose of these tests shall be identified, dated and signed by the analyst performing the test, and submitted.

(c) Performance specifications are delineated in paragraph (d) of this section. For each performance specification, an initial series of seven tests shall be conducted. The results of these tests shall be interpreted as follows:

(1) If the instrument passes all seven (7) tests for a given performance specification, pass the instrument for that specification.

(2) If the instrument fails three (3) or more of the seven tests for a given performance specification, reject the instrument for that specification.

(3) If the instrument fails one or two of the initial series of seven tests for a given performance specification, conduct a second series of eight tests for that performance specification. If the number of test results failing that performance specification in the combined total of 15 test results is:

(i) One or two, pass the instrument for that specification.

(ii) Three or more, reject the instrument for that specification.

(d) PERFORMANCE SPECIFICATIONS FOR AUTOMATED METHODS: TABLE B-1

	Units [a]	SO_2	O_3	CO
1. Range [b]	P.p.m.	0-0.5	0-0.5	0-50
2. Noise	P.p.m.	.005	.005	.50
3. Lower detectable limit	P.p.m.	.01	.01	1.0
4. Interference equivalent:				
Each interferent	P.p.m.	±0.02	±0.02	±1.0
Total interferent	P.p.m.	±0.06	±0.06	±1.5
5. Zero drift:				
12 hour [c]	P.p.m.	±0.02	±0.02	±1.0
24 hour	P.p.m.	±0.02	±0.02	±1.0
6. Span drift	P.p.m.	±0.02	±0.02	±1.0
7. Lag time	Min.	20	20	10
8. Rise time, 95 percent	Min.	15	15	5
9. Fall time, 95 percent	Min.	15	15	5
10. Precision:				
20 percent of upper range limit	P.p.m.	.02	.02	1.0
80 percent of upper range limit	P.p.m.	.03	.02	1.0

[a] To convert from ppm to μg/m³ at 25° C and 760 mm, multiply by M/0.02447 where M is the molecular weight of the gas.

[b] No performance test required. All other performance specifications are tested on instrument operating in the range specified.

[c] Determined by measuring zero air continuously for 12 hours.

§ 53.21 Test procedures for automated methods.

(a) Generation of test atmospheres: Methods to be used for generation of test atmospheres and for verification of the resulting concentrations are given in Table B-2 of this paragraph. The test gas delivery system shall be designed and constructed so as not to alter the test gas composition in any way during the period of the test. The delivery system shall be fabricated from borosilicate glass or FEP Teflon. All diluent air shall be free from contamination. The temperature surrounding the gas generation system shall be controlled within ±2° C. The output of the gas generation system shall be stable to permit valid results of the required test. If a permeation device is employed during generation of the test atmosphere, the permeation device as well as the air passing over the device shall be controlled to ±0.1° C. Samples for verifying test concentrations shall be collected utilizing the same delivery system as close as possible to the sample intake port of the automated method under test. The concentration of each test atmosphere shall be verified by analysis of duplicate samples before and after each series of tests. Schematic drawings and complete procedural details of the test gas generation and delivery system shall be provided.

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(b) TEST ATMOSPHERES—TABLE B-2 (REFERENCES LISTED AT END OF TABLE)

Test gas	Generation	Verification
1. Ammonia	Permeation tube system. Similar procedure to that described in reference 4.	Collect samples in bubbler containing 0.1N HCl. Analyze samples by the [illegible] method, p. 232, reference 1.
2. Carbon dioxide	Cylinder of zero air containing the concentration of CO_2 specified in Table B-3.	Certified analysis by manufacturer, vendor or independent laboratory.
3. Carbon monoxide	Cylinders of zero air containing the concentrations of CO specified in Table B-3.	Certified analysis by manufacturer, vendor or independent laboratory. Recertification required every 6 months.
4. Ethane	Cylinder* of zero air containing 10 p.p.m. ethane. Dilute with zero air to concentration specified in Table B-3.	Certified analysis by manufacturer, vendor or independent laboratory using flame ionization detector calibrated with methane.
5. Ethylene	Cylinder* of "prepurified" nitrogen containing [illegible] p.p.m. ethylene. Dilute with zero air to concentration specified in Table B-3.	Certified analysis by manufacturer, vendor or independent laboratory using flame ionization detector calibrated with methane. Recertification is required every 6 months.
6. Hydrogen chloride	Cylinder* of "prepurified" nitrogen containing [illegible] p.p.m. of gaseous HCl. Dilute with zero air to concentration specified in Table B-3.	Collect samples in bubbler containing distilled water. Analyze samples by the mercuric thiocyanate method, ASTM [illegible], p. 29, reference 2.
7. Hydrogen sulfide	Permeation tube system, p. 436, reference 3.	Tentative method of analysis for H_2S content of the atmosphere, p. 426, reference 3.
8. Methane	Cylinder* of zero air containing the concentration of methane specified in Table B-3.	Certified analysis by manufacturer, vendor or independent laboratory using flame ionization detector calibrated with methane. Recertification is required every 6 months.
9. Nitric oxide	Cylinder* of "prepurified" nitrogen containing 100 p.p.m. NO. Dilute with zero air to concentration specified in Table B-3.	Tentative method of analysis for nitric oxide content of the atmosphere, p. 325, reference 3.
10. Nitrogen dioxide	1. Gas phase titration—description available from NERC RTP. 2. Permeation tube system—procedure similar to that described in reference 4 and modified by NERC RTP.	1. Reference 4, Appendix D: O_3 is titrated against NO which is equivalent to NO_2 formed. 2. Reference 3, page 329.
11. Ozone	Calibrated ozone generator. Procedure described in reference method for photochemical oxidant, reference 1.	KI method. Procedure described in reference method for photochemical oxidant, reference 4.
12. Sulfur dioxide	Permeation tube system. Procedure described in reference method for SO_2, reference 4.	Pararosaniline method. Procedure described in reference method for SO_2, reference 1.
13. Water	Pass zero air through distilled water at a fixed known temperature between 20° to 30° C. such that the air stream becomes saturated. Dilute with zero air to concentration specified in Table B-3.	Measure relative humidity by means of a dew point indicator, calibrated electrolytic or piezoelectric hygrometer or wet/dry bulb thermometer.
14. Xylene	Cylinder* of "prepurified" nitrogen containing 100 p.p.m. xylene. Dilute with zero air to concentration specified in Table B-3.	Certified analysis by manufacturer, vendor or independent laboratory using flame ionization detector calibrated with methane.
15. Zero air	Air having a water content of less than 1,000 p.p.m., hydrocarbon content as methane of less than or equal to 0.1 p.p.m., carbon dioxide content of 350±50 p.p.m. and oxygen content of 21.0±0.5 percent.	Certified analysis by manufacturer, vendor or independent laboratory using flame ionization detector calibrated with methane and infrared detector calibrated with carbon dioxide and by using appropriate analytical techniques for oxygen and water content.

* Use stainless steel pressure regulator dedicated to the pollutant measured.

Ref. 1—Standard Methods for the Examination of Water and Waste Water, 13th Ed., American Public Health Association, [illegible] Washington, D.C.

Ref. 2—[illegible] Book of ASTM Standards, Part 23, American Society for Testing and Materials, 1916 Race St., [illegible]

Ref. 3—Methods of Air Sampling and Analysis, Intersociety Committee, 1972, American Public Health Association, 1015 18th St. NW., Washington, D.C.

Ref. 4—National Primary and Secondary Ambient Air Quality Standards, 40 CFR 50.

(c) Start-up, calibration, and safety requirements:

(1) Set-up and start-up of the instrument shall be in strict accordance with the instrument's instruction manual. Connect the output to a suitable strip chart recorder. (NOTE.—This requirement is not intended to limit data acquisition components. Other components may be used along with the recorder during conduct of these tests. It is intended only to facilitate evaluation of data submitted to EPA for the purpose of demonstrating that a candidate method is an equivalent or reference method.) The recorder shall be of the servo, null-balance type having a chart width of 10 inches or greater, response time of 1 second or less, at least 5 percent below zero or zero offset capability, and deadband of less than 0.25 percent of scale. Allow adequate warm-up or stabilization time as indicated in the instruction manual.

(2) Calibration of the instrument shall be as indicated by the instrument's operation manual. A dynamic calibration curve which has at least 7 identifiable points including 0 and 80 percent of scale shall be submitted. If the chart recorder does not have below zero capability, a 5 percent offset zero shall be employed. The calibration curve shall include a plot of pollutant concentration against chart division or percent of scale and against instrument output in terms of volts or millivolts.

(3) Normal instrument operations or failures shall not generate or present any hazards or hazardous conditions to operators or environment or discharge any hazardous or detrimental effluent gas. Instruments shall include safety devices to prevent hazards or damage to the internal components or performance of the instrument.

§ 53.22 Procedures for measuring performance specifications.

(a) *Range*—(1) *Technical definition.* Nominal minimum and maximum concentrations which the system shall be capable of measuring. The nominal range which shall be used during conduct of all tests is specified in units of parts-per-million by volume in Table B-1 of § 53.20 (d). Pollutant concentration at the lower and upper scale limits are specified, as for example: 0 to 1 ppm.

(2) *Test procedure.* No test procedure is required.

(b) *Noise*—(1) *Technical definition.* Spontaneous, short duration deviations in the instrument output about the mean output, which are not caused by input concentration changes. Noise is determined as the standard deviation about the mean and expressed in concentration units given in Table B-1 of § 53.20(d).

(2) *Test procedure.* (i) Allow sufficient time for instrument warm-up and stabilization. Noise is determined using both zero air and a pollutant test gas concentration as indicated below.

(ii) Recheck strip chart recorder to vertify and demonstrate that recorder deadband is less than 0.25 percent of full scale.

(iii) For this test, it is necessary to disconnect the strip chart recorder from the instrument output, and use instead an integrating type Digital Volt Meter (DVM) accurate to three significant figures on the instrument output. The strip chart tracings shall be submitted along with the DVM readings.

(iv) Sample zero air for 60 minutes.

(v) During this 60-minute interval, record twenty-five (25) random DVM readings.

(vi) Calculate the noise from the 25 DVM readings using the following equations.

(vii) If k_1, k_2 * * * k_n are the individual DVM readings, the mean is determined by

$$\bar{k} = \frac{\Sigma k_i}{25}$$

Deviations about the mean are,

$$d_i = k_i - \bar{K}$$

and the standard deviation (noise) is,

$$S = \frac{\Sigma (d_i)^2}{24}$$

Convert d_i and S to concentration in ppm by reference to the previously determined calibration curve for the instrument.

(viii) Repeat steps (iv) through (vii) using a pollutant test gas concentration producing an output of 80±5 percent of the specified upper range limit.

(c) *Lower detectable limit*—(1) *Technical definition.* The minimum pollutant concentration which produces a signal of twice the noise level.

(2) *Test procedure.* (i) Allow sufficient time for warm-up and stabilization. Sample zero concentration and allow for stable reading to establish zero baseline.

(ii) Generate and sample a test atmosphere equal to the value for the lower detectable limit given in the performance specifications [Table B-1, § 53.20 (d)].

(iii) Record instrument reading. An instrument reading of at least twice the noise level previously determined at 0 ppm is necessary to satisfy the requirement for lower detectable limit sensitivity.

(d) *Interference equivalent*—(1) *Technical definition.* Positive or negative output caused by a substance other than the one being measured.

(2) *Test procedure.* The candidate instrument shall be tested for all interferents specified in Table B-3 of paragraph (e) of this section for the pollutant of interest. The basis for the test is that each candidate method is challenged with those interfering agents known or suspected to cause interference. An interferent may be either positive or negative, depending on whether the instrument's output is increased or decreased by the presence of the interferent. Interference tests are performed by mixing each interferent with the pollutant concentrations specified in Table B-3 of paragraph (e) of this section and comparing the instrument's output to the output caused by the pollutant alone. Known gas phase reactions that occur between the interferent and the pollutant are designated in Table B-3. In these cases, the interfering response shall be determined in the absence of the pollutant.

(i) Allow sufficient time for warm-up and stabilization.

(ii) For instruments using a prefilter or scrubber based on a chemical reaction to derive part of its specificity, and that requires periodic service or maintenance, the instrument shall be "conditioned" prior to each interference test as follows:

(*a*) Service or perform the indicated maintenance on the scrubber or prefilter as directed in the manual.

(*b*) Before testing for each interferent, allow the instrument to sample through the scrubber a test atmosphere containing the interferent at a concentration equal to the value specified in Table B-3 of paragraph (e) of this section. Sampling shall be at the normal flow rate and shall be performed for 6 continuous hours prior to testing.

(iii) Three test atmospheres shall be generated as follows:

(*a*) Test atmosphere X: Specified pollutant concentration.

(*b*) Test atmosphere Y: Specified interferent concentration.

(*c*) Test atmosphere Z: Zero air interferent concentration.

(iv) Adjust the individual flow rates and the pollutant or interferent generators for the three test atmospheres as follows:

(*a*) The flow rates of test atmospheres Y and Z shall be equal.

(*b*) The concentration of pollutant in test atmosphere X shall be adjusted such that when mixed (diluted) with either test atmosphere Y or Z, the resulting concentration of pollutant shall be as specified in Table B-3 of paragraph (e) of this section.

(*c*) The concentration of interferent in test atmosphere Z shall be adjusted such that when mixed (diluted) with test atmosphere X, the resulting concentration of interferent shall be equal to the value specified in Table B-3 of paragraph (e) of this section.

(v) Mix test atmospheres X and Y by passing the total flow of both through a mixing flask.

(vi) Sample and measure the mixture of test atmospheres X and Y. Allow for a stable reading, and record the reading in concentration units.

(vii) Mix test atmospheres X and Z by passing the total flow of both atmospheres through a mixing flask.

(viii) Sample and measure a mixture of test atmosphere X and Z. Allow for a stable reading, and record the reading in concentration units.

(ix) Calculate the interference as the second reading minus the first reading.

(x) Repeat steps (iii) through (ix), in turn, for each interferent.

(xi) For those interferents which cannot be mixed with the pollutant, as indicated in Table B-3 of paragraph (e) of this section adjust the concentration of the interferent in the test atmosphere to the specified value without being mixed or diluted by any other test atmospheres.

(xii) Sample and measure the interferent test atmosphere and allow for a stable reading.

(xiii) Record this reading, in positive or negative concentration units, as the interference equivalent.

(xiv) The sum of the absolute values of the individual interferences shall not exceed the value given in performance specifications [Table B-1 of § 53.20(d)] for the total interference. (NOTE.—Specifications for total interferent are not intended to indicate allowable measurement inaccuracy at the levels of air quality standards. The allowable interferent response stated in the performance specifications results from challenging the measurement system with maximal concentration of potential interferents. If ambient air contained the combined concentration of challenging agents specified for the purpose of these tests, it is most likely that the concentration of the pollutant of interest as reported by the measurement system would far exceed the air quality standard.)

(e) INTERFERENT TEST CONCENTRATION FOR AUTOMATED METHODS IN PARTS PER MILLION: TABLE B-3

Pollutant	Measuring principle	Hydrochloric acid	Ammonia	Hydrogen sulfide	Sulfur dioxide	Nitrogen dioxide	Nitric oxide	Carbon dioxide	Ethylene	Ozone	m-Xylene	Water vapor	Carbon monoxide	Methane	Ethane
SO_2	Flame photometric (FPD)			0.1	[a]0.14			750				[b]25,000	50		
SO_2	Gas chromatography (FPD)			0.1	[a]0.14			750				[b]25,000	50		
SO_2	Spectrophotometric-wet chemical (pararosaniline) [illegible]	0.2	[b]0.1	0.1	[a]0.14	0.5		750		0.5					
SO_2	Electrochemical	0.2	[b]0.1	0.1	[a]0.14	0.5	0.5		0.2	0.5		[b]25,000			
SO_2	Conductivity	0.2	[b]0.1		[a]0.14	0.5		750							
SO_2	Spectrophotometric-gas phase				[a]0.14	0.5	0.5			0.5	0.2				
O_3	Chemiluminescent (other than ethylene)			[b]0.1				750		[a]0.08		[b]25,000			
O_3	Electrochemical		[b]0.1		0.5	0.5				[a]0.08		[b]25,000			
O_3	Spectrophotometric-wet chemical [illegible]		[b]0.1		0.5	0.5	[b]0.5			[a]0.08					
O_3	Spectrophotometric-gas phase [illegible]				0.5	0.5	[b]0.5			[a]0.08					
NO_2	Chemiluminescent		[b]0.1		0.5	[a]0.1	0.5					[b]25,000			
NO_2	Spectrophotometric-wet chemical [illegible]				0.5	[a]0.1	0.5			0.5					
NO_2	Electrochemical				0.5	[a]0.1	0.5			0.5		[b]25,000	50		
NO_2	Spectrophotometric-gas phase				0.5	[a]0.1	0.5				0.2				

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Pollutant	Measuring principle	Hydrochloric acid	Ammonia	Hydrogen sulfide	Sulfur dioxide	Nitrogen dioxide	Nitric oxide	Carbon dioxide	Ethylene	Ozone	m-Xylene	Water vapor	Carbon monoxide	Methane	Ethane
CO	IR (other than reference method).							750				25,000	[c]10		
CO	Gas chromatography-FID.											25,000	[c]10		0.5
CO	Electrochemical						0.5		0.2			25,000	[c]10		
CO	Catalytic combustion-thermal detection.		0.1					750	0.2			25,000	[c]10	5.0	0.5
CO	IR fluorescence							750				25,000	[c]10		0.5
CO	Mercury replacement-UV photometric.								0.2				[c]10		0.5
THC/CH₄	Catalytic combustion-FID.								0.2			25,000	50	[c]2.0	0.5

[a] Concentrations of interferent listed must be prepared to ± 10 percent of stated value and controlled to ± 10 percent.
[b] Do not mix with pollutant.
[c] Concentration of pollutant used for test. These pollutant concentrations must be prepared to ± 10 percent of stated value and controlled to ± 5 percent.

(f) Test procedures for zero drift, span drift, precision, rise time, fall time, lag time:

(1) Determination of these response elements shall be accomplished over a period of at least seven days. During the test, manual adjustments to the electronics, gas or reagent flows shall be permitted only once every three days. Automatic adjustments which are a part of the normal instrument operations are permitted at any time. A sampling plan is given in Table B-4 of paragraph (g) of this section.

(2) Technical definition of zero drift: The change in instrument output over a stated time period of unadjusted continuous operation, when the input concentration of pollutant is zero.

(3) Technical definition of span drift: The change in instrument output over a stated time period of unadjusted continuous operation, when the input pollutant concentration is a stated upscale value.

(4) Test procedure for zero and span drift:

(i) Allow sufficient time for instrument to warm up and stabilize.

(ii) Sample zero air until a stable reading is obtained, and adjust baseline to 5 percent of chart. Instrument is operated at normal line voltage and normal room temperature (normal temperature range is between 20-30° C; normal line voltage range is between 105-125 volts).

(iii) Sample test atmosphere of pollutant concentration equal to 80±5 percent of the upper range limit. Adjust span control as necessary.

(iv) Sample test atmosphere of pollutant concentration equal to 20±5 percent of the upper range limit and record the output.

(v) Hereafter, no manual adjustments shall be made to the instrument, except as indicated in the test plan, and then only after the zero and span readings have been recorded for that day. Allow the instrument to sample ambient air or perform other tests during idle periods.

(vi) Sample test atmosphere of pollutant concentrations of 0, 20, and 80 percent of the upper range limit each day, 24 hours after the previous day's readings. These test concentrations shall be consistent from day to day. Allow sufficient time for stabilization of zero and span output and record the readings in concentration units. Subtract each day's readings from the previous day's respective readings to obtain the zero and span drift for that day.

(vii) Sample and measure zero air continuously for at least 12 hours each day. Determine the minimum and maximum readings during this period of 12 consecutive hours and record the "peak-to-peak" difference, regardless of sign in concentration units, as the 12-hour drift.

(viii) At the beginning of the next 12-hour continuous zero air test, change the line voltage and room temperature to the value given in test plan.

(ix) On the 4th, 7th, 10th, and 13th days as indicated in the test plan, the instrument may be serviced and adjusted after the readings are obtained.

(x) On the 8th day, the test results shall be examined to determine if further testing is required.

(xi) This test shall be conducted either in an uninterrupted period of seven or fifteen days, or periods of three consecutive days during which no adjustments shall be permitted. For example, if the test is interrupted by weekends, it may be performed in three-day periods where adjustments are made on Monday and readings are taken on Tuesday, Wednesday, and Thursday.

(5) Lag time:

(i) Technical definition: The time interval between a step change in input concentration at the instrument inlet to the first observable corresponding change in instrument output.

(ii) Test procedure:

(a) Sample zero air until a stable reading is obtained.

(b) Switch to the test atmosphere used in paragraph (f)(4)(iv) while simultaneously starting a stopwatch.

(c) Observe the instrument output and stop the stopwatch immediately when the first observable change occurs due to the step concentration change in the output.

(d) Record the elapsed time.

(6) Rise time:

(i) Technical definition: The time interval between initial response and 95 percent of final response after a step increase in input concentration.

(ii) Test procedure:

(a) Sample zero air until stable reading is obtained.

(b) Sample a concentration of 80±5 percent of the upper range limit, and obtain a stable reading.

(c) Calculate 95 percent of the reading obtained in paragraph (f)(6)(ii)(b) of this section.

(d) Repeat paragraph (f)(6)(ii)(a) of this section.

(e) Sample the same concentration as in paragraph (b) and use a stopwatch to time the interval starting with the first observable instrument output response, and ending when the response equals the reading calculated in paragraph (f)(6)(ii)(c) of this section.

(f) Record the elapsed time.

(7) Fall time:

(i) Technical definition: The time interval between initial response and 95 percent of final response after a step decrease in input concentration.

(ii) Test procedure:

(a) Sample a concentration of 20±5 percent of the upper range limit, and obtain a stable reading.

(b) Sample zero air and use a stopwatch to time the interval starting with the first observable instrument output response, due to the step change and ending when the response equals 5 percent of the upper range limit, corrected for zero baseline drift based on the zero reading obtained in § 53.22(f)(6) (Rise Time), step (ii)(a).

(c) Record the elapsed time.

(d) Repeat steps (a), (b), and (c).

(8) Precision:

(i) Technical definition: Variation about the mean of repeated measurements of the same concentration. This variation is expressed as one standard deviation about a mean.

(ii) Test procedure:

(a) Allow sufficient time for instrument warm-up and stabilization.

(b) Sample and measure zero air until a stable reading is obtained. Do not record.

(c) Sample a pollutant concentration of 20±5 percent of the upper range limit and obtain a stable reading. Convert to concentration units and record value.

(d) Sample a pollutant concentration at least 50 percent higher (30 percent of full scale: then as in (c) above until a stable reading is obtained. Do not record

(e) Quickly switch to the pollutant concentration used in (c). Record the reading.

(*f*) Repeat steps (b) through (e) two additional times.

(*g*) Calculate and report the mean and standard deviation for these six values.

(*h*) Repeat step (b).

(*i*) Sample a pollutant concentration of 80±5 percent of the upper range limit and obtain a stable reading. Convert to concentration units and record value.

(*j*) Sample a pollutant concentration 20 percent higher than in paragraph (f) (8) (i) of this section. But not to exceed 97 percent of full scale.

(*k*) Quickly switch to the pollutant concentration used in (*j*). Record the reading.

(*l*) Repeat steps (*i*) through (*k*) two additional times.

(*m*) Calculate and report the mean and standard deviation for these six values.

(g) ZERO AND SPAN DRIFT TEST PLAN [a]: TABLE B-4

Day	Morning	Line voltage	Room temperature, ° C.	Afternoon	Night (12 hrs. minimum)
1	Adjust zero and span	125	20	Other tests not requiring adjustments to the instrument may be performed. See test procedures for rise time, fall time, lag time, and precision.[b]	Adjust line voltage and room temperature to values given at right ([c]), ([d]). Sample zero air continuously.
2	Sample and read 0, span 1 and span 2.	105	20		
3	Sample and read 0, span 1 and span 2.	125	30		
4	Sample and read 0, span 1 and span 2; adjustments may be made to the instrument, if necessary, after readings are taken.	105	30		
5	Sample and read 0, span 1 and span 2.	125	20		
6	Sample and read 0, span 1 and span 2	105	20		
7	Sample and read 0, span 1 and span 2; instrument adjustments permitted after readings are taken.	125	30		
8	Sample and read 0, span 1 and span 2[b].	105	30		
9	Sample and read 0, span 1 and span 2.	125	20		
10	Sample and read 0, span 1, span 2; adjustments permitted after readings are taken.	105	20		
11	Sample and read 0, span 1 and span 2.	125	30		
12	Sample and read 0, span 1 and span 2.	105	30		
13	Sample and read 0, span 1, span 2; adjustments permitted after readings are taken.	125	20		
14	Sample and read 0, span 1 and span 2.	105	20		
15	Sample and read 0, span 1 and span 2.	125	30		
16	End of test				

[a] These tests shall be run only once each day. Tests shall also be run either on consecutive days with adjustment permitted every three days or in increments of three consecutive days during which adjustments to the instrument are not permitted.

[b] At this time examine test results to determine if further tests are required.

[c] Voltage specified shall be controlled to ± 1 Volt.

[d] Temperature specified shall be controlled to ± 1° C.

Subpart C—Test Procedures for Demonstrating a Consistent Relationship Between Candidate Methods and Reference Methods

§ 53.30 General provisions.

(a) *Selection of test sites.* The exact location of the sampling sites is left to the discretion of the manufacturer: the sampling sites shall be located in areas of expectant maximum pollutant concentrations. It is expected that reference and equivalent methods are applicable to all ambient air environments which are likely to be encountered. The Administrator retains the discretion to select sampling sites for tests he determines necessary to conduct.

(b) *Test atmosphere.* Unaltered ambient air shall be used for the test. However, when necessary the ambient air may be spiked using a pollutant generator. The ambient air sample shall not be altered in any way except by spiking to bring the pollutant level up to specified test concentrations and/or by addition of potential interfering substances normally found in ambient air. The intake and distribution manifold shall be designed so as not to remove particles or trace gases and insure that identical samples reach the reference and candidate sampling instruments. When spiking is used, at least 60 percent of the sample admitted to the instrument shall be ambient air and the remainder can originate from the pollutant generator. Schematic drawings and complete procedural details of the test system shall be provided.

(c) *Simultaneous sampling.* The party shall conduct simultaneous sampling of the test atmosphere by both the reference and candidate methods. All recorder chart tracings and other documentation resulting from conduct of tests shall be identified and submitted along with test data.

(d) *Operation of measurement systems.* Measurement systems shall be operated in the range specified at § 53.20 (d) (Table B-1).

(e) *Demonstration of consistent relationship.* A consistent relationship is demonstrated when the difference in results between candidate method and reference method meet the tolerance values specified in this subpart.

§ 53.31 Test procedure for oxidant methods.

(a) Calibration:

(1) Calibrate the reference instrumental method prior to conducting the tests in accordance with procedures specified in the appropriate appendix to 40 CFR Part 50.

(2) Calibration of the candidate instrument shall be done in accordance with a method specified by the manufacturer.

(3) Calibration data, procedures, and calculations for both the reference and candidate methods shall be submitted.

NOTE.—Calibrations shall be permitted only once every 72 hours (operational period) for both methods. Manual adjustment to the instruments shall not be permissible during the stated operational period. Control samples shall be introduced to both the reference and candidate instruments or operational checks shall be performed during an operational period.

(4) Both the reference and candidate instruments shall be operated continuously during an operational period.

(b) Ambient air tests:

(1) Tests over 1-hour averaging times shall be conducted at three ambient air or spiked ambient air oxidant concentration ranges: 0.06–1.1 ppm, 0.15–0.25 ppm, and 0.35–0.45 ppm. Hourly average oxidant concentration as measured by the reference method shall fall within the range specified. The hourly average shall be based upon integration of the output signal over the entire hourly span.

(2) Description of the methods used to obtain hourly averages shall be submitted.

(3) The following tests shall be performed. Table C-1 of § 53.31 paragraph (c) delineates the number of measurements needed for each of the concentration ranges and their respective tolerances. It indicates that the total sample size for the first sample set is 14 and the allowable number of times that specifications can be exceeded is 6. Similarly, the size of the second sample set, if required, is 18 and the allowable number of times that specifications can be exceeded for the combined total of both samples (32) is 2.

(c) TEST SPECIFICATIONS FOR OXIDANT AND CARBON MONOXIDE: TABLE C-1

Pollutant range (p.p.m.)	Tolerance, i.e. allowance differences between Cand. and Ref. methods (p.p.m.)	Sample size	
		1st Sample	2d Sample
Oxidant:			
1. Low 0.06-0.10	≦0.02	5	6
2. Med. 0.15-0.25	≦0.03	5	6
3. High 0.035-0.45	≦0.04	4	6
Totals		14	18
Carbon monoxide:			
1. Low 7-11	≦1.5	5	6
2. Med. 20-30	≦2.0	5	6
3. High 35-45	≦3.0	4	6
Totals		14	18

Allowable number of differences which can exceed tolerance specifications for each pollutant.

(d) Sampling procedure: Data shall be collected according to a stratified sampling plan. Sampling shall be conducted in sets of three ranges. Within each set sampling without replacement shall occur. For example, if the first range selected is low, then the next one is either medium or high. Once the second range is selected, the third one is automatically determined. In the above example the first one is low, if the second is high, then the third must be medium. This completes the first set of three. In starting the second set of three, the fourth range cannot be the same as the third. So if the third range was medium, then the fourth shall be either low or high. This begins the second set of three ranges. If the fourth range was high, then the fifth can be either medium or low. Thus, once the fifth range has been selected, the sixth range is determined. This procedure is followed to obtain a sample size of 14 for the first sample and a sample size of 18 for the second sample, if needed. As an additional constraint on the sampling plan, at least 3 and no more than 6 samples per day shall be collected in each of three successive days. A sampling plan is specified in § 53.31(e) (Table C-2). Table C-2 shall be used to select either plan 1, 2, or 3 for a sample size of 14 and if an additional sample of 18 is required, then either plan 4, 5, or 6 shall be used.

(e) SAMPLING PLANS FOR POLLUTANT TEST SPECIFICATIONS. TABLE C-2

For sample size of 14	Time requirement falls between 5 and 10 days
Plan No. 1	HLM, LMH, MHL, MLH, LH.
Plan No. 2	LMH, LHM, LHM, HML, HL.
Plan No. 3	MHL, MHL, HML, MHL, HL.
For sample size of 18	**Time requirement falls between 7 and 13 days**
Plan No. 4	LMH, MHL, HML, MLH, LMH, MHL.
Plan No. 5	LHM, HML, MHL, MHL, MHL, MHL.
Plan No. 6	LMH, LHM, HLM, LMH, MLH, LHM.

NOTE: L=Low concentration range, M=Medium concentration range, H=High concentration range as specified in Table C-1 of § 53.31(b) (3).

(f) Acceptance sampling plan necessary to perform the statistical tests:

(1) The first sample set shall consist of an initial set of 14 measurements. The results of these measurements shall be interpreted as follows:

(i) If the number of measurements from the series of 14 which fail the stated specification does not exceed zero, pass the instrument for consistent relationship.

(ii) If the number of measurements from the series of 14 which fail the stated specification is three or more, reject the instrument for consistent relationship.

(2) If 12 or 13 of measurements from the series of 14 pass the stated specification conduct a second set of 18 test measurements. If the number of measurements failing the consistent relationship test in the combined total of 32 test measurements is:

(i) One or two, pass the instrument for consistent relationship.

(ii) Three or more, reject the instrument for consistent relationship.

§ 53.32 Test procedure for carbon monoxide methods.

(a) Calibration:

(1) Calibrate the reference instrumental method prior to conducting the tests in accordance with procedures specified in the appropriate appendix to 49 CFR part 50.

(2) The candidate instrument shall be calibrated in accordance with the method specified by the manufacturer.

(3) The calibration data, procedures, and calculations for both the reference and candidate methods shall be submitted.

NOTE.—Calibrations shall be permitted only once every 72 hours (operational period) for both methods. Manual adjustments to the instruments shall not be permissible during the stated operational period. Zero and span tests shall be conducted on both the reference and candidate instruments to document that instruments are operating within performance specifications.

(4) Both the reference and candidate instruments shall be operated continuously during an operational period.

(b) Ambient air tests:

(1) Tests over 1-hour averaging times shall be conducted at three ambient air or spiked ambient air carbon monoxide concentration ranges: 7-11 ppm, 20-30 ppm, and 35-45 ppm. Hourly average CO concentration as measured by the reference method shall fall within the range specified. The hourly average shall be based upon continuous integration of the output signal over the entire hourly span, or shall be the average of at least 12 instantaneous signal levels which are at equally spaced intervals over the entire hourly span.

(2) Description of the method used to obtain hourly averages shall be submitted.

(3) The following tests shall be performed. § 53.31(c) delineates the number of measurements needed for each of the concentration ranges and their respective tolerances. It indicates that the total sample size for the first sample is 14 and the allowable number of times specifications that can be exceeded is 0. Similarly, the second sample, if required, is 18 and the allowable number of times specifications can be exceeded for the combined total of both samples (32) is 2.

(c) Sampling procedure:

(1) Data shall be collected according to a stratified sampling plan. Sampling shall be conducted in sets of three ranges. Within each set sampling without replacement shall occur. For example, if the first range selected is low, then the next one is either medium or high. Once the second range is selected the third one is automatically determined. In the above example the first one is low, if the second is high, then the third must be medium. This completes the first set of three. In starting the second set of three, the fourth range cannot be the same as the third. So if the third range was medium, then the fourth shall be either low or high. This begins the second set of three ranges. If the fourth range was high, then the fifth can be either medium or low. Thus, once the fifth range has been selected the sixth range is determined. This procedure is followed to obtain a sample size of 14 for the first sample and a sample size of 18 for the second sample, if needed. As an additional constraint on the sampling plan, at least 3 and no more than 6 samples per day shall be collected in each of three successive days. A sampling plan is specified in § 53.31(e) (Table C-2). Table C-2 shall be used to select either plan 1, 2, or 3 for a sample size of 14 and if an additional sample of 18 is required, then either plan 4, 5, or 6 shall be used.

(2) The acceptance sampling plan necessary to perform the statistical tests is specified as follows:

(i) The first sample set shall consist of an initial set of 14 measurements. The results of these measurements shall be interpreted as follows:

(a) If the number of measurements from the 14 which fail the stated specification does not exceed zero, pass the instrument for consistent relationship.

(b) If the number of measurements from the 14 which fail the stated specification is three or more, reject the instrument for consistent relationship.

(ii) If the number of measurements from the 14 which fail the stated specification is either one or two conduct a second set of 18 test measurements. If the number of measurements failing the consistent relationship test in the combined total of 32 test measurements is:

(a) One or two, pass the instrument for consistent relationship.

(b) Three or more, reject the instrument for consistent relationship.

§ 53.33 Test procedure for sulfur dioxide methods.

A manual reference method has been published in 40 CFR Part 50. The party shall demonstrate a consistent relationship between the candidate method and the reference method in accordance with the following procedures.

(a) *Automated methods.*—(1) *Calibration.* (i) Calibrate the reference method in accordance with the procedure specified in the appropriate appendix to 40 CFR Part 50.

(ii) The candidate automated method shall be calibrated in accordance with the procedure specified by the manufacturer.

(iii) The calibration data for both the reference and candidate methods and the calibration procedure and calculations for the candidate method shall be submitted. NOTE.—Instrument calibration shall be permitted only once every 72 hours (operational period) for the automated method. Manual adjustment to the instrument is not permissible during the stated operational period. Control samples shall be introduced to the candidate instrument or operational checks shall be performed during an operational period to document that the instrument is operating within performance specifications. Control samples shall also be used in the reference method to verify that the method is in calibration and that valid data are being obtained.

(2) *Operation of the instruments.* The candidate instrument shall be operated continuously during the operational period. Simultaneous measurements of pollutant concentrations shall be obtained by means of the reference and candidate methods for the concentration ranges and averaging times specified in § 53.34(b) (Table C-3). On any given day only one 24-hour test result shall be reported for a specified concentration range. In the range 0.40–0.50 ppm, 1-hour and 24-hour measurements shall be obtained concurrently. One-hour average results obtained by the automated method shall be based on continuous integration of the output signal over the 1-hour span or shall be the average of at least 12 instantaneous signal levels which are at equally spaced intervals over the 1-hour span. In like manner, results of 24-hour measurements shall be obtained.

(b) *Test specifications for sulfur dioxide.* (1) The acceptance sampling plan necessary to perform the statistical tests is specified as follows:

(i) The first sample set shall consist of an initial set of 7 measurements. The results of these measurements shall be interpreted as follows:

(*a*) If the number of measurements from the series of 7 which fail the stated specification does not exceed zero, pass the instrument for consistent relationship.

(b) If the number of measurements from the series of 7 which fail the stated specification is three or more, reject the instrument for consistent relationship.

(ii) If the number of measurements from the series of 7 which fail the stated specification is either one or two conduct a second set of 8 test measurements. If the number of measurements failing the consistent relationship test in the combined total of 15 test measurements is:

(*a*) One or two, pass the instrument for consistent relationship.

(*b*) Three or more reject the instrument for consistent relationship.

(2) (i) Data for 24-hour comparisons shall be collected according to the sampling plan given in § 53.33(c) (Table C-4). Table C-4 shall be used to select either plan 1, 2, or 3 for a sample size of 7 and if an additional sample of 8 is required, then either plan 4, 5, or 6 shall be used.

(ii) Sampling shall be conducted in sets of three ranges as specified in § 53.33(b) (Table C-3) and, within each set, sampling without replacement shall occur. For example, if the first range selected is low, the next one is either medium or high. If the second is high, then the third is either medium or low. When obtaining 1-hour measurements, the data shall be collected consecutively over the high range 0.40–0.50 ppm with no more than four 1-hour measurements in a given 24-hour time period.

(b) TEST SPECIFICATIONS FOR SULFUR DIOXIDE: TABLE C-3

SO₂ range (p.p.m.)	Tolerance, i.e., allowable difference between Cand. and Ref. methods	Number of measurements required			
		24 hour measurement		1 hour measurement	
		1st sample set	2nd sample set	1st sample set	2nd sample set
1. Low 0.02-0.05	±0.02	2	3		
2. Med. 0.10-0.15	±0.03	2	2		
3. High 0.40-0.50	±0.04	3	3	7	8
Total		7	8		
Allowable number of differences which can fail tolerance specification		0	2	0	2

(c) Sampling Plans for SO₂ Test Specifications: Table C-4

For Sample Size of 7:

Plan No. 1	H L M H M L H
Plan No. 2	L M H M H L H
Plan No. 3	M H L H M L H

For Sample Size of 8:

Plan No. 4	M H L H L M L H
Plan No. 5	H L M L H M H L
Plan No. 6	L M H M H L H L

NOTE: L=Low Concentration Range, M=Medium Concentration Range, H=High Concentration Range, as specified in Table C-3 of § 53.33(b).

(a) Manual methods:

(1) Calibration:

(i) Calibrate the reference method in accordance with the procedure specified for the reference method in 40 CFR Part 50.

(ii) The candidate manual method shall be calibrated in accordance with the procedure specified by the manufacturer.

(iii) The calibration data for both the reference and candidate methods and the calibration procedure and calculations for the candidate method shall be submitted.

(iv) A detailed procedural description of the candidate method shall be submitted.

(v) Simultaneous measurements of pollutant concentration by means of reference and candidate methods for the specified concentration ranges and averaging times specified in § 53.33(b) (Table C-3) shall be obtained. Note: Control samples may be used to document the validity of the results. On any given day only one 24-hour test result shall be reported for a specified concentration range. In the range 0.40–0.50 ppm, test results for both 3-hour averaging times and 24-hour averaging times shall be obtained in a given day.

(vi) Section 53.33(b) (Table C-3) delineates the number of measurements needed for each of the SO₂ ranges and their respective tolerances for both 24-hour measurements and 1-hour measurements.

Table C-3 indicates that the total sample size for the first sample is 7 and the allowable number of times specifications can be exceeded is 0. Similarly the second sample, if required, is 8 and the allowable number of times specifications can be exceeded for the combined total of both samples (15) is 2.

(2) The acceptance sampling plan necessary to perform the statistical tests is specified as follows:

(i) The first sample set shall consist of an initial set of 7 measurements. The results of these measurements shall be interpreted as follows:

(a) If the number of measurements from the 7 which fail the stated specification does not exceed zero, pass the instrument for consistent relationship.

(b) If the number of measurements from the 7 which fail the stated specification is three or more, reject the instrument for consistent relationship.

(ii) If the number of measurements from the 7 which fail the stated specification is either one or two conduct a second set of 8 test measurements. If the number of measurements failing the consistent relationship test in the combined total of 15 test measurements is:

(*a*) One or two, pass the instrument for consistent relationship.

(*b*) Three or more, reject the instrument for consistent relationship.

(3) Data for 24-hour comparisons shall be collected according to the sampling plan given in § 53.33(c) (Table C-4). Sampling shall be conducted in sets of four ranges as specified in § 53.33(b) (Table C-3) and, within each set, sampling without replacement shall occur. For example, if the first range selected is low, the next one is either medium, high or very high. When obtaining 3-hour measurements, the data are collected consecutively over the high range 0.40–0.50 with no more than four 3 hour measurements in a given 24-hour period.

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APPENDIX II

Air and Industrial Hygiene Laboratory's

Recommended Draft

of

SUBPART B: Test Procedures for Measuring
Performance Characteristics

of the

PROPOSED AMBIENT AIR MONITORING EQUIVALENT
AND REFERENCE METHODS

Subpart B - Test Procedures for Measuring Performance Characteristics

¶53.20 General Provisions

(a) Test procedures applicable to automated candidate and reference methods for observations on Interference, Lower Detectable Limit, Precision, Rise Time, Fall Time, Zero Drift, Span Drift, Lag Time and Noise are described in this Subpart. The methods must pass all the specifications for performance to satisfy the requirements of this subpart. Measurement systems must be operated in the range specified in Table B-1 of paragraph (d) of this section and at normal ambient temperature of 20 to 30°C and normal line voltage of 105 to 125 VAC during the conduct of these tests.

(b) All recorder chart tracings, test data and other documentation obtained from these tests shall be identified, dated and signed by the analyst performing the test, and submitted.

(c) Performance specifications are delineated in ¶(d) of this section. For each performance specification for range, noise, lower detectable limit and interference equivalent, perform the tests as directed in the test procedures. The method or instrument must pass all these specifications before other tests are begun. For each performance specification for drifts, response times and precision, an initial of seven (7) tests shall be conducted. The results of these tests shall be interpreted as follows:

(i) If the instrument passes all seven (7) tests for a given performance specification, pass the instrument for that specification.

(ii) If the instrument fails three (3) or more of the seven tests for a given performance specification, reject the instrument for that specification.

(iii) If the instrument fails one or two of the initial series of seven tests for a given performance specification, conduct a second series of eight tests for that performance specifications. If the number of tests results failing that performance specification in the combined total of 15 test results is:

(a) One or two, pass the instrument for that specification.

(b) Three or more, reject the instrument for that specification.

(d) Performance Specifications for Automated Methods: Table B-1

	Units[a]	SO_2	O_3	CO
1. Range[b]	ppm	0–0.5	0–0.5	0–50
2. Noise, 0%	ppm	0.005	0.005	0.50
, 20%	ppm	0.005	0.005	0.50
3. Lower Detectable Limit	ppm	0.01	0.01	1.0
4. Interference Equivalent				
Each Interferent	ppm	± 0.02	± 0.02	± 1.0
Total of Interferents				
5. Zero Drift				
12 Hour[c]	ppm	± 0.02	± 0.02	± 1.0
24 Hour	ppm	± 0.02	± 0.02	± 1.0
6. Span Drift, 20%	ppm	± 0.02	± 0.02	± 1.0
, 80%	ppm	± 0.02	± 0.02	± 1.0
7. Lag Time	minutes	20	20	10
8. Rise Time, 95%	minutes	15	15	5
9. Fall Time, 95%	minutes	15	15	5
10. Precision				
20% of Upper Range Limit	ppm	0.02	0.02	1.0
80% of Upper Range Limit	ppm	0.03	0.02	1.0

[a] To convert from ppm to $\mu g/m^3$ at 25°C and 760 mm, multiply by M/.02447 where M is the molecular weight of the gas.

[b] No performance test required. All other performance specifications are tested on instrument operating in the range specified.

[c] Determined by measuring zero air continuously for 12 hours.

¶53.21 Test Procedures for Automated Methods

(a) Test Facility

A test room capable of providing controlled temperature to within ± 2°C at ambient conditions will be required for the gas generation system (¶53.21(b)). A second test room or chamber capable of providing temperatures at 20 and 30°C and within ± 2°C will be required for the instrument under test (See ¶53.22(g), Table B-4).

(b) Generation of Test Atmospheres

Methods for generation of test atmospheres and for verification of the test concentrations are given in Table B-2 of this paragraph. The test gas delivery system shall be designed and constructed so as not to alter the test gas composition. The delivery system shall be fabricated from borosilicate glass or FEP Teflon. All diluent air shall be free from contamination. The temperature surrounding the gas generation system shall be controlled within ± 2°C. The output of the gas generation system shall be stable in order to obtain valid results from the tests. If a permeation device is employed during generation of the test atmosphere, the device as well as the air passing over it shall be controlled to ± 0.1°C. Samples for verifying test concentrations shall be collected utilizing the same delivery system as close as possible to the sample intake port of the automated method under test. The concentration of each test atmosphere shall be verified by analysis of duplicate samples before and after each series of tests. Schematic drawings and complete procedural details of the test gas generation and delivery system shall be provided. A suggested system is shown in Figure 1 and as described in ¶53.22(d)(iii).

(c) Test Atmospheres: Table B-2 (References listed at end of table)

Test Gas	Generation	Verification
1. Ammonia	Permeation tube system. Similar procedure to that described in reference 4.	Collect samples in bubbler containing 0.1 N HCl. Analyze samples by the Phenate method, reference 1, after neutralizing excess acid with 0.1 N NaOH.
2. Carbon Dioxide	Cylinder of zero air containing 2X the concentration of CO_2 specified in Table B-3.	Certified analysis by manufacturer or vendor and recertified to be within ± 5% by an independent laboratory just before use.
3. Carbon Monoxide	Cylinders of zero air containing 2X the concentrations of CO specified in Table B-3.	Certified analysis by manufacturer or vendor and recertified to be within ± 5% by an independent laboratory. Recertification required every 6 months.
4. Ethane	Cylinder(a) of zero air containing 10 ppm ethane. Dilute with zero air to concentration specified in Table B-3.	Certified analysis by manufacturer or vendor and recertified to be within ± 5% by an independent laboratory using flame ionization detector calibrated with methane.
5. Ethylene	Cylinder(a) of "prepurified" nitrogen containing 20 ppm ethylene. Dilute with zero air to concentration specified in Table B-3.	Certified analysis by manufacturer or vendor and recertified to be within ± 5% by an independent laboratory using flame ionization detector calibrated with methane. Recertification is required every 6 months.
6. Hydrogen Chloride	Cylinder(a) of "prepurified" nitrogen containing 100 ppm of gaseous HCl. Dilute with zero air to concentration specified in Table B-3.	Collect samples in bubbler containing distilled water. Analyze samples by the mercuric thiocyanate method, ASTM (D5.2), p. 29, reference 2.
7. Hydrogen Sulfide	Permeation tube system, p. 426, reference 3.	Tentative method of analysis for H_2S content of the atmosphere, p. 426, reference 3.

Table B-2 Test Atmospheres (Con't).

Test Gas	Generation	Verification
8. Methane	Cylinder$^{(a)}$ of zero air containing 2X the concentration of methane specified in Table B-3.	Certified analysis by manufacturer or vendor and recertified to be within ± 5% by an independent laboratory using flame ionization detector calibrated with methane. Recertification is required every 6 months.
9. Nitric Oxide	Cylinder$^{(a)}$ of "prepurified" nitrogen containing 100 ppm NO. Dilute with zero air to concentration specified in Table B-3.	Tentative method of analysis for nitric oxide content of the atmosphere, p. 325, reference 3.
10. Nitrogen Dioxide	1. Gas phase titration - description available from NERC-RTP.	1. Reference 4, Appendix D; O_3 is titrated against NO which is equivalent to NO_2 formed.
	2. Permeation tube system - procedure similar to that described in reference 4 and modified by NERC-RTP.	2. Reference 3, page 329.
11. Ozone	Calibrated ozone generator. Procedure described in reference method for photochemical oxidant, reference 4.	KI method. Procedure described in reference method for photochemical oxidant, reference 4.
12. Sulfur Dioxide	Permeation tube system. Procedure described in reference method for SO_2, reference 4.	P-rosaniline method. Procedure described in reference method for SO_2, reference 4.
13. Water	Pass zero air through distilled water at a fixed known temperature between 20° to 30°C such that the air stream becomes saturated. Dilute with zero air to concentration specified in Table B-3.	Measure relative humidity by means of a dew point indicator, calibrated electrolytic or piezoelectric hygrometer or wet/dry bulb thermometer.
14. Xylene	Cylinder$^{(a)}$ of "prepurified" nitrogen containing 100 ppm xylene. Dilute with zero air to concentration specified in Table B-3.	Certified analysis by manufacturer or vendor and recertified to be within ± 5% by an independent laboratory using flame ionization detector calibrated with methane.

Table B-2 Test Atmospheres (Con't).

Test Gas	Generation	Verification
15. Zero Air	Air having a water content of less than 1000 ppm, hydrocarbon content as methane of less than or equal to 0.1 ppm, carbon dioxide content of 350 ± 30 ppm and oxygen content of 21.0 ± 0.5%.	Certified analysis by manufacturer or vendor, and recertified to be within ± 5% by an independent laboratory using flame ionization detector calibrated with methane and infrared detector calibrated with carbon dioxide and by using appropriate analytical techniques for oxygen and water content.

[a] Use stainless steel pressure regulator.

Ref. 1 - Tentative Method of Analysis for Ammonia in the Atmosphere (Indophenol Method), Intersociety Committee Method 42604-01-72T, Health Laboratory Science, Volume 10, No. 2 (April 1973)

Ref. 2 - 1970 Annual Book of ASTM Standards, Part 23, American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania.

Ref. 3 - Methods of Air Sampling and Analysis, Intersociety Committee, 1972, American Public Health Association, 1915 18th Street, N.W., Washington, D.C.

Ref. 4 - Part 50 - National Primary and Secondary Ambient Air Quality Standards, Federal Register. November 25, 1971, [36 FR 22384].

(d) Start-up, Calibration, and Safety Requirements

(1) Set-up and start-up of the instrument shall be in strict accordance with the instrument's instruction manual. Connect the output to a suitable strip chart recorder. (Note: This requirement is not intended to limit data acquisition components. Other components may be used along with the recorder during conduct of these tests. It is intended only to facilitate evaluation of data submitted to EPA for the purpose of demonstrating that a candidate method is an equivalent or reference method.) The recorder shall be of the servo, null-balance type having a chart width of 10" or greater, response time of 1 second or less, at least 5% below zero or zero offset capability, and deadband of less than 0.25% of scale. Allow adequate warm-up or stabilization time as indicated in the instruction manual.

(2) Calibration of the instrument shall be as indicated by the instrument's operation manual. Adjust the instrument controls, when possible, to obtain a 5% offset zero reading on the recorder chart. A dynamic calibration curve which has at least 7 identifiable points including 0 and 90% of full scale shall be submitted. The slope of the curve shall be determined by the best-fit least square method and the values plotted in terms of pollutant concentration against chart division or percent of scale and

against instrument output in terms of volts, millivolts, milliamps or other appropriate units.

(3) Normal instrument operations or failures shall not generate or present any hazards or hazardous conditions to operators or environment or discharge any hazardous or detrimental effluent gas. Instruments shall be equipped with safety devices to prevent hazards and/or damage to the internal components of such instruments.

¶53.22 Procedures for Measuring Performance Specifications

(a) Range

(1) Technical Definition: Nominal minimum and maximum concentrations which the system shall be capable of measuring. The nominal range which shall be used during conduct of all tests is specified in units of parts-per-million by volume in Table B-1 of ¶53.20(d). Pollutant concentrations at the lower and upper scale limits are specified, as for example: 0 to 1 ppm.

(2) Test Procedure: No test procedure is required.

(b) Noise

(1) Technical Definition: Spontaneous, short duration deviations in the instrument output about the mean output, which are not caused by input concentration changes. Noise is determined as the standard deviation about the mean and expressed in concentration units. The specifications are given in Table B-1 of ¶53.20(d).

(2) Test Procedure:

(i) Allow sufficient time for instrument warm-up and stabilization. Noise is determined using both zero air and a pollutant test gas concentration as indicated below.

(ii) For this test, it is necessary to disconnect the strip chart recorder from the instrument output, and use instead an integrating type Digital Meter (DM) accurate to three significant figures.

(iii) Sample zero air for 60 minutes.

(iv) During this 60-minute interval, record twenty-five (25) random DM readings.

(v) Convert the individual DM readings k_1, k_2---k_{25} to concentration units c_1, c_2---c_{25} by reference to the previously determined calibration curve of the analyzer, and determine the mean by:

$$\bar{c} = \frac{\sum c_i}{25}$$

Deviations about the mean are determined by

$$d_i = c_i - \bar{c}$$

and the standard deviation or noise is,

$$s = \sqrt{\frac{\sum (d_i)^2}{24}}$$

Report the noise at 0% of the upper range limit in ppm.

(vi) Repeat steps (iv) through (v) using a pollutant test gas concentration producing an output of 80 ± 5% of the specified upper range limit and report the noise.

(c) Lower Detectable Limit

(1) Technical Definition: The minimum pollutant concentration which produces a signal of twice the noise level.

(2) Test Procedure:

(i) Allow sufficient time for warm-up and stabilization. Sample zero air and allow for stable reading to establish zero baseline.

(ii) Generate a test atmosphere equal to 20 ± 5% of the upper range limit. Verify the concentration with the reference procedure. Calculate and increase accordingly the diluent air flow rate to obtain the concentration specified for lower detectable limit in Table

B-1. Sample the gas stream. Record the stable reading.

(iii) Convert the reading to concentration unit. Pass the instrument for this specification, if this value is equal to or greater than twice the noise at zero obtained in ¶53.22(b)(2)(v).

(d) Interference Equivalent

(1) Technical Definition: Positive or negative output caused by a substance other than the one being measured.

(2) Test Procedure: The candidate instrument shall be tested for all interferents specified in Table B-3 of ¶(e) of this section for the pollutant of interest. The basis for the test is that each candidate method is challenged with those interfering agents known or suspected to cause interference. The interference may be either positive or negative, depending on whether the instrument's output is increased or decreased by the presence of the interferent. Interference tests are performed by mixing each interferent with each of the pollutant concentrations specified in Table B-3 of ¶(e) of this section, sampling the mixtures and comparing the instrument's output to the output caused by the pollutant alone. In cases where the pollutant and the interferent are known to react in the gas phase as designated in Table B-3, the interference equivalent shall be determined in the absence of the pollutant.

(i) Allow sufficient time for warm-up and stabilization.

(ii) For instruments using a prefilter or scrubber based upon a chemical reaction to derive part of its specificity, and that requires periodic service or maintenance, the instrument shall be "conditioned" prior to each interference test as follows:

(a) Service or perform the indicated maintenance on the scrubber or prefilter as directed in the manual.

(b) Before testing for each interferent, allow the instrument to sample through the scrubber a test atmosphere containing the interferent at a concentration equal to the value specified in Table B-3 of ¶(e) of this section. Sampling shall be at the normal flow rate and shall be performed for 6 continuous hours prior to testing.

(iii) Three test atmospheres shall be generated as follows:

(a) Test atmosphere P: Pollutant concentration.

(b) Test atmosphere I: Interferent concentration.

(c) Test atmosphere Z: Zero air.

(iv) Adjust the flow rates of P, I and Z as follows:

(a) The flow rates of test atmospheres I and Z shall be equal.

(b) The concentration of pollutant in test atmosphere P shall be adjusted such that when mixed (diluted) with either test atmosphere I or Z, the resulting concentration of pollutant shall be as specified in Table B-3 of ¶(e).

(c) The concentration of interferent in test atmosphere I shall be adjusted such that when mixed (diluted) with test atmosphere P, the resulting concentration of interferent shall be equal to the value specified in Table B-3 of paragraph (e) of this section.

(v) Mix test atmospheres P and Z by passing the total flow of both atmospheres through a mixing flask.

(vi) Sample the mixture of test atmospheres P and Z. Record the stable reading.

(vii) Mix test atmospheres P and I by passing the total flow of both atmospheres through a mixing flask.

(viii) Sample the mixture of test atmospheres P and I. Record the stable reading.

(ix) Convert the first and second readings to concentration units, C_1 and C_2, respectively. Calculate the interference equivalent, IE = $C_2 - C_1$.

(x) Follow steps (iii) through (ix) to determine the IE for each interferent.

(xi) For those interferents which cannot be mixed with the pollutant, as indicated in Table B-3 of ¶(e) adjust the concentration of the interferent in the test atmosphere to the specified value without being mixed or diluted by any other test atmospheres.

(xii) After stable zero, sample the interferent test atmosphere until a stable reading is obtained.

(xiii) Convert the net reading to concentration unit and report as the interference equivalent. This value can either be positive or negative.

(xiv) The sum of the absolute values of the individual interference equivalents for the specified interferents shall not exceed the value given in performance specifications [Table B-1 of ¶53.20(d)] for the total interference. (Note: Specifications for total interference are not intended to indicate allowable measurement inaccuracy at the levels of air quality standards. The allowable interferent response stated in the performance specifications results from challenging

(e) Interferent Test Concentration for Automated Methods in Parts Per Million[a]: Table B-3

Pollutant	Measuring Principle	Hydrochloric Acid	Ammonia	Hydrogen Sulfide	Sulfur Dioxide	Nitrogen Dioxide	Nitric Oxide	Carbon Dioxide	Ethylene	Ozone	m-Xylene	Water Vapor	Carbon Monoxide	Methane	Ethane
SO_2	Flame Photometric (FPD)			0.1	0.14^c			750				$18{,}000^b$	50		
SO_2	Gas Chromatography-(FPD)			0.1	0.14^c			750				$18{,}000^b$	50		
SO_2	Spectrophotometric-Wet Chemical (Pararosaniline Reaction)	0.2	0.1^b	0.1	0.14^c	0.5		750		0.5					
SO_2	Electrochemical	0.2	0.1^b	0.1	0.14^c	0.5	0.5		0.2	0.5		$18{,}000^b$			
SO_2	Conductivity	0.2	0.1^b		0.14^c	0.5		750							
SO_2	Spectrophotometric-Gas Phase				0.14^c	0.5	0.5			0.5	0.2				
O_3	Chemiluminescent (other than ref. method)			0.1^b				750		0.08^c		$18{,}000^b$			
O_3	Electrochemical		0.1^b		0.5	0.5				0.08^c		$18{,}000^b$			
O_3	Spectrophotometric-Wet Chemical (potassium Iodide Reaction)		0.1^b		0.5	0.5	0.5^b			0.08^c					
	Spectrophotometric-Gas Phase				0.5	0.5	0.5^b			0.08^c					
NO_2	Chemiluminescent		0.1^b		0.5	0.1^c	0.5					$18{,}000^b$			

(e) **Interferent Test Concentration for Automated Methods in Parts Per Million[a]: Table B-3 (Continued)**

Pollutant	Measuring Principle	Hydrochloric Acid	Ammonia	Hydrogen Sulfide	Sulfur Dioxide	Nitrogen Dioxide	Nitric Oxide	Carbon Dioxide	Ethylene	Ozone	m-Xylene	Water Vapor	Carbon Monoxide	Methane	Ethane
NO_2	Spectrophotometric-Wet Chemical (Azo-Dye Reaction)				0.5	0.1[c]	0.5			0.5					
NO_2	Electrochemical				0.5	0.1[c]	0.5			0.5		18,000[b]	50		
NO_2	Spectrophotometric-Gas Phase				0.5	0.1[c]	0.5				0.2				
CO	IR (other than reference method)							750				18,000	10[c]		
CO	Gas Chromatography FID											18,000	10[c]		0.5
CO	Electrochemical						0.5		0.2			18,000	10[c]		
CO	Catalytic Combustion-Thermal Detection		0.1					750	0.2			18,000	10[c]	5.0	0.5
CO	IF Fluorescence							750				18,000	10[c]		0.5
CO	Mercury Replacement-UV Photometric								0.2				10[c]		0.5
THC/ CH_4	Catalytic Combustion-FPD								0.2			18,000	50	2.0[c]	0.5

Notes: [a] Concentrations of interferent listed must be prepared and controlled to ± 5% of the stated value.

[b] Do not mix with pollutant.

[c] Concentration of pollutant used for test. These pollutant concentrations must be prepared and controlled to ± 5% of the stated value.

the measurement system with maximal concentration of potential interferents. If ambient air contained the combined concentration of challenging agents specified for the purpose of these tests, it is most likely that the concentration of the concentration of the pollutant of interest as reported by the measurement system would far exceed the air quality standard.)

(f) Test Procedures for Zero Drift, Span Drift, Precision, Rise Time, Fall Time, Lag Time

(1) Determination of these response elements shall be accomplished over a period of at least seven (7) days. During the test, manual adjustments to the electronics, gas or reagent flows shall be permitted only once every three days. Automatic adjustments which are a part of the normal instrument operations are permitted at any time. A sampling plan is given in Table B-4 of ¶(g) of this section.

(2) Technical Definition of Zero Drift: The change in instrument output over a stated time period of unadjusted continuous operation, when the input concentration of pollutant is zero.

(3) Technical Definition of Span Drift: The change in instrument output over a stated time period of unadjusted continuous operation, when the input pollutant concentration is a stated upscale value.

(4) Test Procedure for Zero and Span Drift:

(i) Allow sufficient time for instrument to warm up and stabilize at normal line voltage of 125 VAC and normal room temperature of 20°C.

(ii) Sample zero air until a stable reading is obtained, and adjust baseline to 5% of chart [see ¶53.21(c)(2)].

(iii) Sample test atmosphere of pollutant concentration equal to 80 ± 5% (Span 1) of the upper range limit. Adjust span control as necessary. Rezero the instrument. Where the zero and span controls are not electrically independent, the adjustments may require repeated trials.

(iv) Sample test atmosphere of pollutant concentration equal to 20 ± 5% (Span 2) of the upper range limit and record the output. Start Day 0.

(v) Hereafter, no manual adjustments shall be made to the instrument, except as indicated in the test plan, and then only after the zero and span readings have been recorded for that day. Allow the instrument to sample ambient air or perform other tests during idle periods.

(vi) In the evening of Day 0, sample zero air for a minimum of 12 hours. Each morning, starting on

Day 1 determine the minimum and maximum readings during this period and record the difference of the readings in concentration units as the daily 12-hour zero drift. Starting in the evening of Day 1 and each evening thereafter, adjust the line voltage and room temperature according to Table B-4 before this test is begun.

(vii) Each day, twenty-four (24) hours after the previous day's readings and starting on Day 1, sample air and test atmospheres containing pollutant concentrations equal to 20 ± 5% (Span 2) and 80 ± 5% (Span 1) of the upper range limit. The test concentrations shall be consistent from day to day. Record the stable readings at zero and at each span concentration.

(viii) Convert the readings to concentration units. Subtract each day's values respectively from that of the previous day and record as the 24-hour zero drift and span drifts at 20 and 80% of the upper range limit for that day.

(ix) Determine lag time, rise time, fall time and precision as outlined in ¶53.22(f)(5) to ¶53.22(f)(8) after the zero and span drift tests have been completed for the day.

(x) Repeat steps (vi) to (ix) daily for an uninterrupted period of seven (7) or fifteen (15) days during which no adjustments to the instrument shall be permitted. To avoid testing during weekends, the tests may be performed in three day periods where adjustments are made on Monday and determinations are made on Tuesday, Wednesday and Thursday or adjustments may be made on Tuesday and determinations are made on Wednesday, Thursday and Friday. All adjustments to the instrument shall be made at the normal line voltage and room temperature of the previous day.

(xi) At the end of Day 7, examine the test results and determine whether to continue or terminate further testing as directed in ¶53.20.

(5) Lag Time

(i) Technical Definition: The time interval between a step change in input concentration at the instrument inlet to the first observable corresponding change equal to twice the noise in instrument output.

(ii) Test Procedure:

(a) Sample zero air until a stable reading is obtained.

(b) Switch to the test atmosphere used in ¶(f)(4)(iii) while simultaneously starting a stopwatch.

(c) Observe the instrument output and stop the stopwatch immediately when the first observable change equal to twice the noise obtained in ¶53.22 (a)(2)(viii) occurs due to the step concentration change in the output.

(d) Record the elapsed time as the lag time.

(6) Rise Time

(i) Technical Definition: The time interval between initial response and 95% of final response after a step increase in input concentration.

(ii) Test Procedure:

(a) Sample zero air until stable reading is obtained.

(b) Calculate 95% of the stable reading in ¶53.22(f)(4)(iii).

(c) Sample the same concentration (80 ± 5%) used in ¶53.22(f)(4)(iii) and use a stopwatch to time the interval starting with the first observable response and ending when the response equals the reading in (b) above.

(d) Record the elapsed time, and allow the analyzer to continue sampling until a stable reading is obtained in preparation for the fall time test [see ¶53.22(f)(7)(ii) below].

(e) Repeat steps (a), (c) and (d) above after completion of fall time test.

(f) Report the average of the values obtained in steps (c) and (e).

(7) Fall Time

(i) Technical Definition: The time interval between initial response and 95% of final response after a step decrease in input concentration.

(ii) Test Procedure:

(a) Calculate 5% of the stable reading in (f)(6)(ii)(d) of the rise time procedure.

(b) While the analyzer is at stable reading from sampling the concentration in (f)(6)(ii)(d) above, switch to sample zero air and use a stopwatch to time the interval starting with the first observable instrument response due to the step change and ending when the response equals the value calculated in (a) above.

(c) Record the elapsed time.

(d) Repeat steps (a), (b) and (c).

(e) Report the average of the values obtained in steps (c) and (d).

(8) Precision

(i) Technical Definition: Variation about the mean of repeated measurements of the same concentration. This variation is expressed as one standard deviation about a mean.

(ii) Test Procedure:

(a) Allow sufficient time for instrument warm-up and stabilization.

(b) Sample zero air until a stable reading is obtained. Do not record.

(c) Sample the same pollutant concentration of 20 ± 5% of the upper range limit as used in §53.22(f)(4)(vii). Record the stable reading.

(d) Sample a pollutant concentration at least 50% higher (30% of full scale) than in ¶(c) above until a stable reading is obtained. Do not record.

(e) Quickly switch to the pollutant concentration used in (c). Record the reading.

(f) Add to the readings obtained in steps (c) and (e), the reading on the same day for the span at 20 ± 5% of the upper range limit in ¶53.22(f)(4)(vii).

(g) Convert the readings to concentration units and calculate the mean and the standard deviation for the three values.

(h) Repeat step (b).

(i) Sample the same pollutant concentration of 80 ± 5% of the upper range limit as used in ¶53.22(f)(4)(vii). Record the stable reading.

(j) Sample a pollutant concentration 20% higher than in ¶(i) but not to exceed 97% of full scale. Do not record.

(k) Quickly switch to the pollutant concentration used in (i). Record the reading.

(l) Add to the readings obtained in steps (i) and (k), the reading obtained on the same day for the span at 80 ± 5% of the upper range limit in ¶53.22(f)(4)(vii).

(m) Convert the readings to concentration units and calculate the mean and standard deviation for the three values.

(n) Report the values obtained in steps (g) and (m) as the precision at 20 and 80% of the upper range limit, respectively.

Zero and Span Drift Test Plan[a]: Table B-4

		Every Night[e] Adjust Test Conditions to:		
Day	Morning	Line Voltage[c]	Room Temp, °C[d]	Day
0	Adjust zero and Span 1 (80 ± 5% of range). Sample Span 2 (20 ± 5% of range). Record the stable readings. No instrument adjustments permitted hereafter until after Day 3 readings.	125	20	0
1	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2, 24 hours after Day 0 readings.	105	20	1
2	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	125	30	2
3	Determine the 12-hour zero drift, sample 0, Span 1 and Span 2; adjustments may be made to the instrument, if necessary, after readings are taken.	105	30	3
4	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	125	20	4
5	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	105	20	5
6	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2; instrument adjustments permitted after readings are taken.	125	30	6
7	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2[b]	105	30	7
8	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	125	20	8
9	Determine the 12-hour zero drift; sample 0, Span 1, Span 2; adjustments permitted after readings are taken.	105	20	9
10	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	125	30	10
11	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	105	30	11
12	Determine the 12-hour zero drift; sample 0, Span 1 and			

	Span 2; adjustments permitted after readings are taken.	125	20	12
13	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	105	20	13
14	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2	125	30	14
15	Determine the 12-hour zero drift; sample 0, Span 1 and Span 2; End of test	-	-	15

[a] These tests shall be run only once each day. Tests shall also be run either on consecutive days with adjustments permitted every three days or in increments of three consecutive days during which adjustments to the instrument are not permitted. In the afternoon, other tests not requiring adjustments to the instrument may be performed, i.e., for rise time, fall time, lag time and precision.

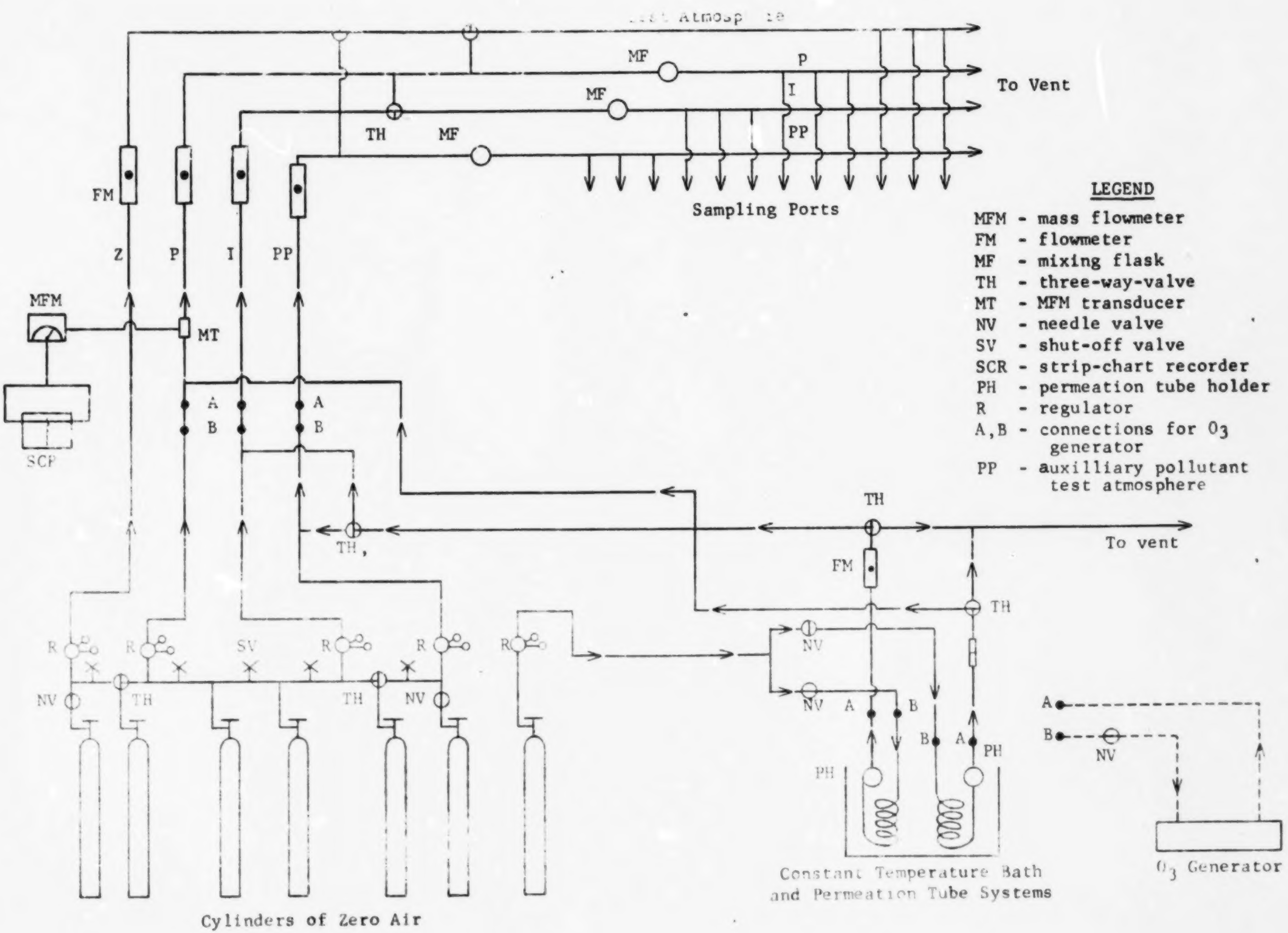
[b] At this time examine test results to determine if further tests are required.

[c] Voltage specified shall be controlled to ± 1 volt.

[d] Temperature specified shall be controlled to ± 2°C.

[e] Sample zero air continuously for a minimum of 12-hours.

GAS GENERATION SYSTEM


Test Atmosphere
To Vent
MF
MF
MF
TH
P
I
PP
FM
Z
P
I
PP
Sampling Ports
MFM
MT
SCR
A
B
A
B
TH,
TH
FM
To vent
TH
NV
NV
A
B
B
A
PH
PH
R
R
SV
R
R
R
NV
TH
TH
NV
Cylinders of Zero Air
Constant Temperature Bath and Permeation Tube Systems
A
B
NV
O3 Generator
LEGEND
MFM - mass flowmeter
FM - flowmeter
MF - mixing flask
TH - three-way-valve
MT - MFM transducer
NV - needle valve
SV - shut-off valve
SCR - strip-chart recorder
PH - permeation tube holder
R - regulator
A,B - connections for O3 generator
PP - auxilliary pollutant test atmosphere

APPENDIX III

Air and Industrial Hygiene Laboratory's
Recommended Draft

of

SUBPART C: Test Procedures for Demonstrating
Consistent Relationship

of the

PROPOSED AMBIENT AIR MONITORING EQUIVALENT
AND REFERENCE METHODS

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Subpart C - Test Procedures for Demonstrating A Consistent Relationship Between Candidate and Reference Methods

¶53.30 General Provisions

(a) Selection of Test Sites: The exact location of the sampling sites is left to the discretion of the applicant but shall be located in the areas of expectant maximum pollutant concentrations. The Administrator retains the discretion to select sampling sites for tests he determines necessary to conduct.

(b) Test Atmposhere: When possible unaltered ambient air shall be used for the tests. The tests shall be conducted at three pollutant levels (low, medium and high) as specified in Tables C-1 and C-3. To obtain the specified test concentrations, the pollutant levels of the ambient air may be increased by using a pollutant generator or decreased by using zero air. The volume dilution resulting from the addition of pollutant or zero air shall be adjusted such that the test atmosphere shall consist of at least 60% ambient air at all times.

Oxidant levels may be adjusted with an ozone generator, sulfur dioxide levels with a permeation tube system and that for carbon monoxide a cylinder containing 100% gas may be used (see Table B-2).

(c) Test Conditions: The reference and candidate methods shall be operated in the measuring ranges specified in Table B-1 of ¶53.20(d). They shall be properly calibrated before the tests are initiated. All measurements shall be conducted at normal temperature of 20 to 30°C and normal line voltage of 105 to 125 VAC.

The sampling system shall consist of an intake and distribution manifold which have been designed and constructed so as not to remove airborne particles and trace gases and insure that identical samples reach the reference and candidate methods. Schematic drawings and complete details of the system shall be submitted by the applicant.

(d) Sampling Procedure: The test atmospheres shall be simultaneously sampled by both the reference and candidate methods. The tests shall be conducted at three specified pollutant levels and in accordance with the sampling plan provided for each test procedure. The tests shall be performed in one or two sample sets. The first set consists of the minimum number of measurements necessary to pass or fail a method for consistent relationship. The second set consists of additional measurements required when the method failed in the first set in one or two specifications only. The results are averaged over the sampling periods specified for each test procedure.

All recorder chart tracings and other documentation resulting from conduct of the tests shall be identified and submitted along with the test data.

(e) Demonstration of Consistent Relationship: A consistent relationship is demonstrated when the differences in the average results obtained by the reference and candidate methods meet the tolerance specifications given in this subpart.

¶53.31 Test Procedure for Oxidant, Carbon Monoxide and Sulfur Dioxide Methods.

(a) Calibration

(1) When the reference method is an instrumental method, calibrate the instrument prior to conducting the tests in accordance with the procedure specified in the appropriate appendix to 40 C.F.R. Part 50 or succeeding codes. When the reference method is a manual method, prepare a standard calibration curve with at least 7 points in the measuring range specified in Table B-1 of ¶53.20(d).

(2) When the candidate method is an instrumental method, calibrate the instrument before conducting the tests in accordance with the procedure specified by the manufacturer. In the absence of such a procedure, perform a dynamic calibration with at least 7 identifiable points including 0 and 90% of the upper range limit and in accordance with the

appropriate procedure specified in the appendix to 40 C.F.R. Part 50 or succeeding codes. For a manual candidate method prepare a standard calibration curve with at least 7 points in the measuring range specified in Table B-1 of §53.20(d).

(3) Submit calibration procedures, calculations and data.

(4) Subsequent calibrations shall be permitted only during the time interval between operational periods for both methods. An operational period is 72 hours of continuous operation during which no manual adjustments to the electronic, gas or reagent flows of the instrument are permissible. Automatic adjustments which are a part of the normal operation of the instruments are permitted at any time.

(b) Sampling Procedure:

(1) After proper warm-up and stablization, connect the sampling probes of the reference and candidate methods to the distribution manifold of the ambient air sampling system.

(2) Refer to Table C-1 or C-3 for the test concentrations required. Select one of the test sampling plans in Table C-2 or C-3.

(3) Sample each test atmosphere simultaneously with the reference and candidate methods in accordance with the selected sampling plan.

No substitution in the plan shall be made until 14 samples have been collected for the first test set or 18 samples for the second set for oxidant and carbon monoxide methods. For sulfur dioxide methods, no substitution in the selected plan shall be made until 7 samples have been collected for the first set or 8 samples for the second set. When necessary adjust the pollutant concentrations in the sample air to the desired levels with a pollutant generator or zero air [see ¶53.30(b)] such that the hourly average concentrations as measured by the reference method fall within the specified ranges.

(4) At each concentration range, collect one-hour samples for oxidant and carbon monoxide methods. For sulfur dioxide methods collect 24-hour samples and in addition collect 1-hour samples at the high concentration range.

(5) Conduct the tests by operational periods [see ¶53.31(a)(4)]. Introduce control samples or perform operational checks during these periods to verify that the methods are performing within specifications. Control samples or checks that show deviations of more than ± 5% from the latest calibration indicate possible calibration shift or instrumental malfunction. Discontinue

testing. Consult the operating instructions or the manufacturer and correct the cause of the problem. Recalibrate the method and restart the testing from the beginning of the operational period.

(6) During an operational period, collect at least three (3) but no more than six (6) samples per day for oxidants and carbon monoxide methods and one (1) 24-hour sample per day for sulfur dioxide methods. Additionally, concurrent with the 24-hour samples, collect two (2) or three (3) 1-hour samples at the high pollutant concentration range for sulfur dioxide methods.

(7) The hourly results shall be averaged based upon integration of the continuous output signals or by averaging at least 12 instantaneous signal levels at equally spaced intervals over the 1-hour sampling periods. For the 24-hour measurements, at least 22 hours of continuous output signals shall be integrated and reported as the 24-hour average results. Description of the methods (i.e. planimetry, etc.) used to obtain the average results shall be submitted.

(8) Examine the results after completing the first test set. Analyze the results in accordance with the statistical acceptance sampling plan in ¶53.31(e) or ¶53.31(h). Determine whether the method has passed or failed to demonstrate consistent

relationship with the reference method or whether further testing with the second set is required.

(9) From the combined results of the first and second test sets, determine whether the candidate method has demonstrated consistent relationship with the reference method according to the acceptance sampling plans in ¶53.31(e) or ¶53.31(h).

(10) Submit all recorder tracings and other supporting documents together with the test data.

(c) Test Specifications for Oxidant and Carbon Monoxide: Table C-1

Pollutant Range (ppm)	Tolerance, i.e. Allowance Differences between Cand. & Ref. Methods (ppm)		Sample Size 1st Sample	Sample Size 2nd Sample
Oxidant				
1. Low 0.06-0.10	±0.02		5	6
2. Med. 0.15-0.25	±0.03		4	6
3. High 0.35-0.45	±0.04		5	6
		Totals	14	18
Carbon Monoxide				
1. Low 7-11	±1.5		5	6
2. Med. 20-30	±2.0		4	6
3. High 35-45	±3.0		5	6
		Totals	14	18

(d) Sampling Plans for Oxidant and Carbon Monoxide Test Specifications: Table C-2

For sample size of 14	Time requirement falls between 5 and 10 days
Plan #1	HLM, LMH, MHL, MLH, LH
Plan #2	LMH, LHM, LHM, HML, HL
Plan #3	MHL, MHL, HML, MHL, HL
For Sample size of 18	**Time requirement falls between 7 and 13 days**
Plan #4	LMH, MHL, HML, MLH, LMH, MHL
Plan #5	LHM, HML, MHL, MHL, MHL, MHL
Plan #6	LMH, LHM, HLM, LMH, MLH, LHM

Note: L = Low Concentration Range, M = Medium Concentration Range, H = High Concentration Range as specified in Table C-1 of §53.31(c).

(e) Acceptance Sampling for Oxidant and Carbon Monoxide Methods:

(1) The results of the first test consisting of 14 measurements shall be interpreted as follows:

(i) If the number of measurements from the series of 14 which fail the stated tolerances does not exceed zero, pass the method for consistent relationship.

(ii) If the number of measurements from the series of 14 which fail the stated tolerances is three or more, reject the method for consistent relationship.

(2) If the number of measurements from the series of 14 which fail the stated specification is one or two, conduct a second set of 18 measurements. If the number of measurements failing the stated tolerances of the combined tests of 32 measurements is:

(i) One or two, pass the method for consistent relationship.

(ii) Three or more, reject the method for consistent relationship.

(f) Test Specifications for Sulfur Dioxide: Table C-3

		Number of Measurements Required			
		24 Hr. Meas.		1 Hr. Meas.	
SO_2 Range (ppm)	Tolerance, i.e. Allowable Diff. Between Cand. & Ref. Methods	1st Sample Set	2nd Sample Set	1st Sample Set	2nd Sample Set
1. Low 0.02-0.05	±0.02	2	3	---	---
2. Med. 0.10-0.15	±0.03	2	2	---	---
3. High 0.40-0.50	±0.04	3	3	7	8
	TOTAL	7	8	7	8

(g) Sampling Plans for SO_2 Test Specifications: Table C-4

For Sample Size of 7

Plan #1	H L M H M L H
Plan #2	L M H M H L H
Plan #3	M H L H M L H

For Sample Size of 8

Plan #4	M H L H L M L H
Plan #5	H L M L H M H L
Plan #6	L M H M H L H L

Note: L = Low Concentration Range, M = Medium Concentration Range, H = High Concentration Range, as specified in Table C-3 of ¶52.31(f).

(h) Acceptance Sampling Plan for Sulfur Dioxide Methods:

(1) The results of the first test consisting of 7 24-hour and 1-hour measurements each shall be interpreted as follows:

(i) If the number of measurements from each series of 7 which fail the stated tolerances does not exceed zero, pass the methods for consistent relationship.

(ii) If the number of measurements from each series of 7 which fail the stated tolerances is three or more, reject the method for consistent relationship.

(2) If the number of measurements from each series of 7 which fail the stated tolerances is either one or two, conduct a second test of 8 measurements. If the number of measurements failing the stated tolerances from the combined total of 15 measurements for each series is:

(a) One or two, pass the method for consistent relationship.

(b) Three or more, reject the method for consistent relationship.

APPENDIX IV

Air and Industrial Hygiene Laboratory's Review of the Comments and Recommendations Submitted by Respondents on EPA's Proposed Ambient Air Monitoring Equivalent and Reference Methods As Published in the Federal Register October 12, 1973

Prepared by

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Prepared for

Environmental Protection Agency
Research Triangle Park, North Carolina 27711

March 1974

Federal Contract No. 68-02-0744

LIST OF RESPONDENTS

Agency/Location	Author
Government Agencies:	
1. California State Air Resources Board Sacramento, California	Kinosian
2. Commissioner of Air Pollution Control St. Louis, Missouri	Copley
3. Kansas State Department of Health Topeka, Kansas	Sides
4. Los Angeles County Air Pollution Control District, Los Angeles, California	Lunche
5. Maryland State Environmental Health Administration, Baltimore, Maryland	Ferreri
6. Montgomery County Department of Environmental Protection, Rockville, Maryland	Mendelsohn
7. New York State Department of Environmental Conservation, Albany, New York	Diamond
8. Oklahoma State Department of Health Oklahoma City, Oklahoma	Blanche

9.	Oregon State Department of Environmental Quality, Portland, Oregon	Myles
10.	San Bernardino County Air Pollution Control District, San Bernardino, California	O'Malley
11.	Tennesse Valley Authority Chattanooga, Tennesse	Gartrell
12.	Wayne County Department of Health Detroit, Michigan	Warner
13.	U.S. Department of Interior Washington, DC	Seidl
14.	U.S. EPA, Office of Air Quality Planning and Standardization, Research Triangle Park, North Carolina	Schueneman
15.	U.S. Office of Environmental Affairs Washington, DC	Cromwell
16.	U.S. EPA Region III Philadelphia, Pennsylvania	Belanger

Private Agencies:

17.	American Electric Power and Service Corp. New York, New York	Reeves
18.	American Smelting and Refining Co. Salt Lake City, Utah	Nelson
19.	Beckman Instruments, Inc. Fullerton, California	Chapman
20.	Commonwealth Edison Chicago, Illinois	Fancher
21.	Ecology Board, Inc. Chatsworth, California	Chand
22.	Edison Electric Institute New York, New York	Crawford
23.	Environmental Research and Technology Inc. Lexington, Massachusetts	Muldoon
24.	Exxon Corporation Washington, DC	Keller

25.	Meloy Labs Springfield, Illinois	Baer
26.	Southern Services, Inc. Birmingham, Alabama	Craig

Private Individuals:

27.	Philadelphia, Pennsylvania	Cropper
28.	San Jose, California	Mage
29.	Birmingham, Alabama	McRanie

REVIEW OF RESPONDENTS' COMMENTS AND RECOMMENDATIONS ON SUBPART A

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RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-1	40 CFR 53/Overall	12	Test program appears thorough.	Generally we agree. However, we do not believe it is complete, e.g. test procedure for the effect of particles should be included.
A-2		2	Procedures and specifications are so complicated and legalistic and leave so little allowance for judgment and the cost of certification will be so excessive, especially for small manufactures, that once certified, there will be little incentive for change.	We disagree with respect to the comment on the intricacies of the test procedures. We believe the specifications are practical. We agree that cost of certification will not be cheap. However, we disagree that certification will stifle development of superior methods.

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-3		3	The regulations, as proposed, will force every agency to establish and maintain an expensive calibration and test facility to certify existing and proposed candidate methods.	40 CFR 53 should state that the responsibility for certification of new analyzers rests with the manufacturer and not with the user. For existing equipment, 40 CFR 53 requests information regarding the respondent's statu and possible replacement of potentially non-conforming instruments and alternate proposal
A-4		3	To reduce duplication of effort, EPA should publish names and models of instruments that EPA has already found to meet these specifications.	EPA as yet does not have such information.

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-5		10	San Bernardino County, California APCD would not be able to conduct and maintain such an extensive program without additional funding.	See Item A-3 above.
A-6		5	EPA must furnish technical assistance and funding to carryout the tasks indicated in 40 CFR 53.	See Item A-3 above.
A-7		24	The elaborate test procedures proposed may cause undue hardship on smaller manufacturers. EPA should consider conducting the testing either in-house or by contract to another laboratory.	No comment

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESPONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-8		27	The paper work and test facility requirements assume a highly centralized operation. Most state and local agencies will not be able to conduct subparts A and B. The administrator should have the option to declare instruments in place on October 12, 1973 as equivalent upon presentation of data that confirms partial compliance with subparts B and C.	See Item A-3 above.
A-9		22	EPA should delay implementation of 40 CFR 53 until the collaborative tests of the methods currently in progress by ASTM (Project Threshold), Midwest Research Institute and Southwest Research Institute are completed.	The organizations mentioned are testing the accuracy and precis of primarily manual methods, no equivalency determinations.

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-10		14	40 CFR 53 should not be implemented until at least two instruments are known to be certifiable.	We believe the test procedures of the regulations as improved by AIHL are practical and the specifications are attainable. We also know of 2 automated methods that meet the requireme of the regulations.
A-11		7	EPA should leave the development of such testing procedures to professional standards organization such as NBS and ASTM. This would avoid duplication of efforts and provide a division between methodology and effort and thus avoid any changes of conflict of interest.	No comment

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP- ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-12		22	40 CFR 53 is too harsh on existing instrumentation since replacement may be required as soon as 6 to 12 months whereas the analyzer life may be 20 years.	No comment
A-13		22	EPA should entrust development of such test procedures to NBS, ASTM or ANSI and avoid conflict of interest between the methods and enforcement.	No comment
A-14		22	We are concerned 40 CFR 53 may not accomplish their purpose in a fair and equitable manner, avoid adding unnecessary costs, avoid arresting analyzer technology and may place undue hardship on smaller manufacturers.	EPA has made every effort to be fair, minimize cost, and encourag new innovations in analyzer technology consistent with the EPA's obligations.

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-15		20	40 CFR 53 does not equate candidate methods with reference methods since we believe the reference methods cannot meet these standards. Hence, 40 CFR 53 should be called a "performance standard".	Our experiences indicate that at least one analyzer which uses th reference principle meets the performance specifications in Subparts B and C.
A-16		20	The experience and expertise of standards authorities such as NBS, ASTM and ANSI should be included in the development of such test procedures.	The regulations was proposed in the Federal Register in order that everyone can participate in the development of the final version. The proposed version has included the input of air pollution experts in the country
A-17		25	The pararosaniline (West-Gaeke) procedure responds to other oxides other than SO_2. The national standard	Total sulfur includes reduced sulfur compounds (e.g. H_2S, mercaptans) as well as sulfur oxide

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESPONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-17 (Con't.)		25	refers to sulfur oxides measured as SO_2 by the reference method. Therefore, the reference and equivalency methods should be changed to monitor total sulfur.	The West-Gaeke procedure as published in the Federal Register is relatively specific for SO_2.
A-18	Pg. 28438, Col 2 and 3, ¶ 2 of 40 CFR 53	19	This paragraph refers to 40 CFR 50 and mentions the fact that EPA designated analysis methods for 6 pollutants as reference but does not indicate that 40 CFR 53 is to be limited to 3 pollutants.	The paragraph summarizes the authority and pertinent basis for promulgation of 40 CFR 53. On pg. 28439, Col. 2, ¶53.4(a), it is stated that 40 CFR 53 applies only to automated methods that measure SO_2, CO and photochemical oxidants. To avoid confusion, add "regulations for the other three pollutants, NO_2, total hydrocarbon an particulate matter are to be established later".

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-19	pg. 29438, Col. 3, ¶4/ Reference to 40 CFR 51 and 53.5(e)(2).	12	We interpret this paragraph to mean that when a method being used in an accepted implementation plan is declared by EPA within 2 yrs. as a reference method, then the user need not demonstrate equivalency for that method. If the method, however, is not accepted within 2 yrs., then the user must act to validate his instrument. But, 53.5(e)(2) requires the instrument performance must be maintained for at least one year of operation. This means the tests must be conducted over a one year period. This requirement appears unrealistic in view of the fact that many State's implementation programs are already underway.	5.3.5(e)(2) requires that approv methods (analyzers) shall functi within specifications for at lea one year. If the Administrator finds that a representative meth fails to perform as required, th approval shall be cancelled. No procedure for testing is given.

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-20		16	The test procedures apply to independent analyzer units and not to units that may be incorporated into a system. An additional paragraph (53.15) below is suggested. "53.15 Inclusion of Methods in Automated Systems When a designated equivalent method or reference method is included in an automated system package designed by a contractor other than the manufacturer of the methods, details of the system shall be reported by the contractor to the Administrator at least 30 days prior to the beginning of hardware construction. The submission shall include specifications, drawings, data-handling procedures, and	We tend to agree.

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATION
A-20 (Con't.)		16	operating, maintenance and calibration procedures. Where an alteration in a method has been made, the submission shall also include a statement that the modification has been made, state the reason for the modification, and show in detail the departures from the method as approved or designated. In systems placing designated/equivalent methods or designated reference methods under the control of computers, the submission shall include a description of the software including a statement of functions and flow-charts. Because these programs usually are modified in the de-bugging phase, a final set of software documentation shall	
R			be submitted upon completion of system installation, showing any deviations	

ITEM	SECTION/LINE-TOPIC	RESPONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATION
A-20 (Con't)		16	from the first submission. Where internal functions of approved or designated methods are replaced by computer control, the submission shall compare the computer control with the original functions. If the Administrator makes a preliminary finding that the methods, as applied to the system, do not satisfy the requirements of this part, he shall notify the applicant within 30 calendar days of the report of his intention not to accept the methods as applied as designated equivalent or designated reference methods. If the Administrator finds that the methods, as applied to the system satisfy the requirements of this part, he shall forward to the applicant a letter to that effect."	

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATION
A-21	pg. 28439, Column 1, ¶ 3 Operation and replacement of existing analyzers.	1	The regulations is not clear whether existing analyzers are to be accepted as equivalent. Recommend that all analyzers in use prior to Oct. 12, 1973 be accepted as equivalent. California has over 200 analyzers in operation. The state has purchased nearly 40 analyzers that are reference or will meet equivalency. Many local agencies have also replaced older units with newer generation instruments. Up to 5 yrs. may be required to replace all non-conforming instruments.	We recommend that all analyzers in place on Oct. 12, 1973 that do not conform to 40 CFR 53 should be accepted as equivalent for a period of 2 yrs. after promulgation of 40 CFR 53 and fo a period of up to 5 additional years upon demonstration of consistent relationship at the sampling site every 2 yrs. Also see respondent's comments in A-30 below.

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-22	pg 28439 Col. 1, ¶3 Operation and replacement of existing analyzers.	9	Over 80% of Oregon's SO_2 analyzers are conductimetric. These do not meet the requirements of 40 CFR 53 because of their response to ions such as HCl and NH_3. Since these interferents are not present in significant amounts in Oregon, these analyzers should be exempted.	See Item A-21 above
A-23		2	St. Louis has 5 analyzers for SO_2 (conductimetric Davis), 5 for CO (NDIR), 4 for total oxidant (neutral KI with filter for SO_2 and data corrected for NO_2), and one for O_3 (chemiluminescent). Total oxidant units met the requirements in 40 CFR 51. SO_2 units will not meet 40 CFR 53 due to response to inter-	See Item A-21 above.

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-23 (Con't.)		2	ferents but since the instruments correct for CO_2 and since the other potential interferents (NH_3, HCl, NO_2) are absent, we believe these units provide valid data and should be allowed to operate for at least 5 yrs. upon demonstration of consistent relationship at the site.	
A-24		17	All analyzers in use on Oct. 12, 1973 should be considered equivalent for the duration of their useful life (up to 20 yrs.).	See Item A-21 above.
A-25		3	All analyzers in the state of Kansas conform to the requirements in 40 CFR 51 except for NO_2 units. Assuming availability of funds, it would take until some time in 1977 to convert to 40 CFR 53 equipment.	See Item A-21 above.

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-26		8	All existing analyzers for SO_2 and O_3 in the state of Oklahoma meet the requirements in 40 CFR 51 but not 40 CFR 53. These were selected with EPA Region VI's and RTP's advice and approval. Such equipment should be allowed to operate until normal attrition replaces all with conforming instruments.	See Item A-21 above.
A-27		4	All methods used to obtain the data on which the air quality standards are based should be accepted as equivalent.	See Item A-21 above.

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-28		7	The state of New York has 65 analyzers; 26 for SO_2 (16 colorimetric, 6 FPD, 5 coulometric, 1 GC), 16 for CO (NDIR), 22 for ozone (chemiluminescent) and 1 for CO-total HC in addition to analyzers for NO, NO_2, total oxidant by KI, COH and total HC by FID. We estimate 2 yrs. to convert to all conforming equipment depending on the availability of funds, time and personnel.	See Item A-21 above.

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-28 (Con't.)		7	We believe all existing equipment that meets most of the critical performance specifications (substantial equivalency) should be accepted until the end of normal life.	See Item A-21 above.
A-29		14	EPA should allow use of existing equipment for up to 3 yrs. for those based on reference principles and one year for other principles.	See Item A-21 above.
A-30		11	Add "Upon promulgation of Part 53, (1) a period of X months will be allowed for testing of all existing equipment for conformance under Part 53; (2) existing monitoring	See Item A-21 above.

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-30	(Con't.)	11	data will be allowed during the test period; (3) a period of Y months will be allowed to replace nonconforming equipment; and (4) existing monitoring data will be allowed during this period".	
A-31		18	American Smelting and Refining Co. has conductimetric (Thomas Autometer) for monitoring SO_2 at 50 smelters. Long term data indicate potential interferents such as HCl and NH_3 are absent. The proposed regulations should be amended to make clear that they are not intended to preclude the use of Thomas autometers	See Item A-21 above.

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-31	(Con't)	18	or similar instruments in approved ICS systems where these instruments are shown to be satisfactory under local conditions in which they will operate.	
A-32		26	Consideration by EPA to permit continued operation of instruments purchased before Oct. 12, 1973 is proper and a procedure for allowing the use of such equipment should be delineated.	See Item A-21 above.
A-33	pg. 28439, Col 2, ¶2/ Responsibility for determination	2	It is not clear who-the manufacturer or the control agency is to conduct these tests. It is inconceivable that most states	The responsibility for equivalency or reference determination rests with the applicant (pg. 28439, Col 2, ¶1).

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-33 (Con.t)		2	are capable and only the largest manufacturers would have such facilities. The burden should be on the manufacturer. For existing equipment, some other arrangement should be made.	The paragraph should indicate clearly that for instruments in place on or before Oct. 12, 197 the applicant in most cases is user and that for instruments s after Oct. 12, 1973, the applic is manufacturer.
A-34		12	It is not clear who-the manufacturer or the user-is to assume the responsibility for demonstrating the validity of their instruments. Our interpretation is that the burden is on the user either by instituting his own program or by appeal to the manufacturer. We believe the burden should be on the manufacturer only or in collaboration with EPA.	See also Item A-33 above.

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-35	pg. 28440, 53.4-53.14. 53.4-53.14.	12	The capability of equivalence laboratories should be tested with EPA test atmosphere.	EPA should establish a quality assurance program to check the capability of equivalence laboratories.
A-36	pg. 28440, 53.4(c-f) and 53.5 (c-1)/General Requirements	2	A paragraph should be added requiring manufacturers to guarantee availability of replacement parts for some number of years and furnish proof of such action to EPA with perhaps a performance bond.	While this is desirable, EPA should investigate whether this would be legally enforceable.
A-37	pg. 28440, 53.1(e) and 53.5/Reference Methods	29	When a reference method is replaced by another method, the previous reference method should be considered equivalent.	EPA should consider some type of variance program.

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-38	pg. 28440, 53.1(e); 53.4(d),(e),(f); 5.310(2); 53.11(c).	26	The word "method" is used interchangeably with the word "technique". "Method" should be used to mean the measurement principle. "Technique" should refer to the instrument family. It is not clear from the text whether the measurement principle, instrument family or individual instruments are to be certified.	Revise text to make clear that instrument is to be certified in cases of automated methods.
A-39		27	Use "instrument system or device" in place of "method".	See Item A-38 above.
A-40	pg. 28440, 53.1 (c-i) and other places.	28	Stipulate that individual instruments are to be certified. The use of the word "method" interchangeably with	See Item A-38 above.

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-40 (Con't.)		28	"technique" infers that only certification of the measurement principle is required. Other paragraphs, 53.4(d),(e),(f), and 53.11(c) infers that individual instruments are to be certified.	
A-41	pg. 28440, Col. 1, ¶53.3/Request for Equivalent or Reference Method Determination.	25	A time limit should be specified so that all manufacturers will have the same opportunity to be on the first selection list.	It may be possible for EPA to announce in the Federal Register a schedule of publication dates (deadlines) for submissions to insure inclusion of the applicant method on the next announcement of certified instruments.

ITEM	SECTION/LINE-TOPIC	RESPONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-42	pg. 28440, ¶53.4(a)	26	No information regarding the status of NO_2 is given even though it is known that EPA is re-evaluating analytical techniques for NO_2. Some statement regarding this pollutant should be made.	40 CFR 53 clearly states that these procedures apply only to methods for CO, SO_2 and photochemical oxidant. See also Item A-18.
A-43	pg. 28440, ¶53.4 (d)(1)	25	Some of the information (components schematic diagrams) is proprietary. A description of the measurement principle, manufacturer's name, general schematics of the sample flow and electronics should be sufficient.	Schematic diagrams are usually r proprietary but the description of some components (i.e., ingredients of converters and prefilters) may be. Proprietary i formation appears to be adequat covered by ¶53.14.
			Requirements for model numbers are unrealistic since minor changes to interface with buyer's system may require different model designation.	We do not agree.

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-44	pg. 28440, 53.4(d) and (e).	4	53.4(d) concerns the descriptive information and sworn statements to be submitted and 53.4(e) concerns the operation manual. It is suggested that ¶53.4 be recorded so that ¶(d) concerns descriptive information to be submitted, and (e) concerns sworn statements to be submitted. Then, the operation manual, which contains descriptive material, would be transfered to sub ¶(d), and sub ¶s(d)(4) and (d)(5) to ¶(e).	Separate descriptive information from sworn statements unless it is the intent of this section to require that the descriptive information in 53.4(d)(1),(2) and (3) are to be submitted in the form of sworn statements.
A-45	pg. 28440, 53.4(d)(2)	26	Since sworn statements can be misinterpreted, the determination of equivalence should be based on the test data 53.4(c) submitted.	It is the intent to use sworn statements to supplement the test data submitted in accordance with 53.4(c).

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-45 (Con't.)		26	Proper safeguards should be developed to insure the quality control programs developed in 53.4(d)(2) are adhered to.	Appears to be covered by 53.4([illegible])
A-46		25	The quality assurance and quality control programs of some manufacturers may include proprietary items. Release of such information in detail is not proper.	See Item A-43.
A-47	pg. 28440, 53.4(d)(4)	25	The meaning of the statement "representative of measurement systems tested" is not clear. Suggest "representative in construction, design, and performance specifications of the measurement systems tested."	Insert "in construction, design and performance specifications' between "representative" and " in 53.4(d)(4) and 53.5(4).

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESPONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-48	pg. 28440, 53.4(c)/ Operation manual	26	The operation manual provided to the purchaser should include all the data submitted to EPA for certification purposes.	The buyer need only know that the instrument meets the requirements of the regulations.
A-49		29 26	The operation manual stipulated in 53.4(c) and 53.5(d) should include all the data that was submitted to EPA to achieve certification.	See Item A-48 above.
A-50	pg. 28440, 53.4(f)(i) and 53.5(e)(i)	25	The requirement that the "methods shall function properly---for at least one year in the field" is unnecessarily harsh on the manufacturer. It should be phrased to state "for at least one year after delivery to the customer", which is consistent with standard practice.	We agree.

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-51	pg. 28440, 53.4(f) and 53.5(e).	2	How is durability to be determined? Who is to conduct the tests after the one year period - the manufacturer or the purchaser?	Under paragraphs 53.4(f)(2) and 53.5(e)(2), the Administrator ma determine compliance based on manufacturer's statements and test data or the Administrator m conduct his own tests.
A-52	pg. 28440, 53.4(f)(2) and 53.5(e)(2)	26	How does EPA propose to inform buyers when certification is cancelled. Announcement in the Federal Register may not suffice.	According to 53.10(c), cancellation shall be published in the Federal Register. Since the instrument buyer must rely on the Federal Register for informatio concerning changes in Federal regulations, announcement in the Federal Register is the proper means for cancelling certificati

ITEM	SECTION/LINE-TOPIC	RESPONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-53		2	What recourse does the buyer have in the event certification is cancelled? Civil suits are expensive and time-consuming. Possibly a performance bond should be required of the manufacturers.	Under paragraphs 53.4(f), 53.5(e) and 53.10, the purchaser has no recourse in the event certification is cancelled. Perhaps EPA should require some type of performance bond of the manufacturer as a condition of certification or perhaps the purchaser can require a bond as condition of sale.
A-54	pg. 28440, 53.5(d)/ Operation manual	25	A comprehensive description of the calibration and testing procedures followed is not needed by the ultimate buyer because test procedures are published by the government and available to the public and also since the government intends to publish those methods which have passed the tests and are therefore acceptable	Substitute the word "operational" for "testing" in 53.5(c)(3), line This change will make 53.5(c)(3) correspond to 53.4(d)(3).

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-55	pg. 28441, 53.6 through 53.10.	26	Notice of all pending actions regarding equivalence and cancellation should be published in the Federal Register to warn prospective purchasers.	We do not agree. The manufacturer is "innocent until proven guilty".
A-56	pg. 28441, 53.6	25	Change "60 calendar days" to "15 calendar days" since 60 days is an unreasonable delay for the manufacturer. Government has a responsibility to process the results of such restrictive actions promptly.	Do not change; the time to respon to the applicant will depend on the number of submissions being reviewed and on the completeness of the applicant's submission. The 15 days proposed is insufficient without a large staff of reviewers.
A-57	pg. 28441, 53.6(d)	25	Add "the additional tests will be thoroughly defined for the manufacturer and a reasonable	The paragraph states that the tes are to be conducted by the Admini tractor, not the manufacturer. T

ITEM	SECTION/LINE-TOPIC	RESPONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-57 (Con't.)		25	specified time limit be given to conduct the tests". The 60 day limitation for approval should also be changed to 15 days.	additional tests to be conducted would be those published in 40 CFR 53. See also Item A-56.
A-58	pg. 28441, 53.71 Right of entry.	25	Right of entry provision should be deleted as this may involve entering areas where proprietary activities and development are being conducted.	The purpose of right of entry is to assure proper conduct of the equivalency test procedures. This requirement is analogous to government inspectors entering food and drug processing and similar industries to insure compliance with government regulations. See also Item A-43.
A-59		25	Also, it should be stipulated that the government will reimburse any costs incurred by the	The text states that the tests to be conducted are for the purpose of assisting the applicant in the

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-59	(Con't.)	25	company during conduct of any tests conducted at the applicant's facility by EPA.	equivalency or reference determination as well as to determine compliance with the regulations. We do not believe that the government should reimburse the company for such expense.
A-60	pg. 28491, 53.8	29	The word "method" should not be used to mean "instrument".	See Item A-38 above.
A-61	pg. 28441, 53.10	4	When an approved method has been revised by the manufacturer to avoid cancellation, such revisions should be published.	We agree.
A-62	53.10(c)	4	Reference in 53.10(c), line 8 to 53.10 should be 53.10(2)(b).	Add "(b)" to 53.10 in line 8 of 53.10(c)

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-63	53.10, 53.13	25	53.10 and 53.13 permit no right of appeal until after the lengthy and therefore costly cancellation procedures in 53.10 have been exhausted. Some provision for right of prior appeal should be provided.	According to 53.10(a)(2), the applicant (manufacturer) has the option of demonstrating to the Administrator that the method in question does meet the requirements of this part or he may make any adjustments needed to bring the method into compliance. We believe this provision constitutes prior appeal.
A-64	53.11	26	Adequate provisions should be made for input from the purchasers during these hearings.	The restrictions in 53.11(d)(1)(iii) do not preclude purchasers as expert witnesses.
A-65	pg. 28442, 53.12 Modification	25 17 29 22	The definition of modification is too broad and requires the manufacturer to report any trivial and insignificant changes.	Add "that will affect the performance of the instrument" between "method" and "including" in line 3 of 53.12 and line 4 of 53.13.

RESPONSES TO SUBPART A

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
A-65	(Con't.)	2	¶53.12 should be changed to read "when significant changes...which affect the performance of the method".	
A-66	pg. 28442, 53.13	27 26 4	The statement "any modification of the construction or design of the method shall be cause for cancellation" would freeze the design of the method. Change the word "shall" to "may". This change will make 53.13 conform in intent and meaning to 53.12.	Delete remainder of paragraph starting with "Any" in line 9 of 53.13 and substitute remainder of paragraph 53.12 starting with "If the administrator----etc."

REVIEW OF RESPONDENTS' COMMENTS AND RECOMMENDATIONS ON SUBPART B

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-1	pg. 28442 53.20(a)	26	Terms used in 53.20(a) should be defined in 53.10.	Respondent probably meant 53.1. Relevant terms are sufficiently defined in the test procedures.
B-2	pg. 28442	4	Include a test for linearity since most telemetering systems accommodate only linear outputs.	EPA should consider a test for linearity.
B-3	pg. 28442 53.20(c)	25 27	This section indicates that seven tests shall be performed for each performance specification, including all of those in Table B-4. This certainly is unnecessary for noise, lower detectable limit, and interference equivalent.	Proposed EPA draft reviewed Feb. 4, 1974 by AIHL stipulates a minimum of 7 tests for each parameter except for range.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-4	pg. 28442 53.20(c)	29	All of a sudden, "instrument" is used, rather than "method".	In AIHL Sept.-Oct. 1973 Progress Report, Appendix I, instrument is used as the preferred word for automated method. EPA should clearly define "Method" and "Instrument" or "Analyzer" in Subpart A.
B-5	pg. 28442 53.20(d) Table B-1	1 2 4 19 25 28	Footnotes to Table B-1 do not apply correctly as they appear out of sequence. Footnote b, not c, applies to range, while footnote c, not d, applies to zero drift.	This was corrected in the AIHL suggested draft of Subpart B, Appendix I, Sept.-Oct. 1973 Progress Report.
B-6	pg. 28442 53.20(d) Table B-1	28 5 6	Ranges specified are too low, since they are below the federal emergency warning level. They should be at	We agree. The possible relaxatio of standards due to energy crisis situations may require more

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-6 (Con't.)		6	least at the emergency level and preferably 10% higher. Also, 0.5 ppm O_3 is regularly exceeded in California, and 50 ppm CO can be obtained in almost any city.	flexibility in the measurement ranges of SO_2 and O_3 methods.
B-7	pg. 28442 53.20(d) Table B-1	1	Increase O_3 range from 0-0.5 ppm to 0-1.0 ppm.	There seems to be a plurality sentiment in favor of increased range - See Item B-6.
B-8	pg. 28442 53.20(d) Table B-1	4	Increase O_3 range to 1.5 ppm	See Item B-6.
B-9	pg. 28442 53.20(d) Table B-1	6	Increase O_3 range to 0.7 ppm (our emergency level is 0-0.6 ppm.)	See Item B-6

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-10	pg. 28442 53.20(d) Table B-1	1	Increase CO range, from 0 to 50 ppm to 0-100 ppm.	See Item B-6.
B-11	pg. 28442 53.20(d) Table B-1	6	Increase CO range to between 100 and 150 ppm, since major downtown intersections often exceed 50 ppm.	See Item B-6.
B-12	pg. 28442 53.20(d) Table B-1	4	Increase CO range to 150 ppm.	See Item B-6.
B-13	pg. 28442 53.20(d) Table B-1	25 26	Total sulfur should be used as the standard, rather than SO_2, as the former includes toxic gases such as SO_3, H_2S + mercaptans.	We disagree. Later it may be important to develop separate standards for each of these gases.
B-14	pg. 28442 53.20(d) Table B-1	29	Some instruments now produced have 0 to 0.5 ppm SO_2 range and cannot be modified to another range.	Required SO_2 range in Table B-1 is 0-0.5 ppm.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-15	pg. 28442 53.20(d) Table B-1	17 23	Some instruments have log-linear SO_2 range, and thus can measure 0 to 1.00 ppm SO_2 while still having high precision at low SO_2 values. The SO_2 range should be changed to reflect this to allow 0-1.00 ppm.	Multi-range capabilities are covered in the EPA Feb. 4, 1974 draft.
B-16	pg. 28442 53.20(d) Table B-1	26 29	A more reasonable range for SO_2 field sampling is 0 to 1.00 ppm.	See Item B-15 above.
B-17	pg. 28442 53.20(d) Table B-1	4	The range for SO_2 should be 0-5.00 ppm.	Seems excessive - See Items B-6, B-14 and B-15 above.
B-18	pg. 28442 53.20(d) Table B-1	5	The 0-0.5 ppm SO_2 range for SO_2 is less than the recommended warning level and should be revised.	See Items B-6 and B-15.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-19	pg. 28442 53.20(d) Table B-1	15	The range values given in Table B-1 imply that 0 ppm is a measureable level which is impossible. Some finite level below the lower detectable limit should be specified, or the definition of range changed.	53.22(a) defines "Range" as "the nominal minimum and maximum concentrations...."
B-20	pg. 28442 53.20(d) Table B-1	25	The noise values should have ± values.	Corrected in the AIHL suggested draft of Subpart B in the Sept.-Oct. 1973 Progress Report, Appendix I.
B-21	pg. 28442 53.20(d) Table B-1	26	Noise spec. is acceptable.	We agree.
B-22	pg. 28442 53.20(d) Table B-1	29	Noise spec. is reasonably tight.	We agree.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-23	pg. 28442 53.20(d) Table B-1.	7	Reduce SO_2 noise spec. from ± .005 to ± 0.002 ppm.	At the current state of the art, ± 0.005 ppm is optimal.
B-24	pg. 28442 53.20(d) Table B-1.	7	Reduce O_3 noise spec. from ± .005 ppm to ± .002 ppm, which will then allow a reduction in lower detectable limit to .004 ppm.	See Item B-3 above.
B-25	pg. 28442 53.20(d) Table B-1	26 29	Since allowable noise is ± 0.005 ppm, it may be difficult to read the lower detectable limit of 0.01 ppm, since this latter value is coincident with 2X noise.	It is not necessary to determine the value below a 2X reading. One must determine only if there is a reading equal to or greater than 2X noise. It is likely that a change of 2X noise is actually due to a concentration change.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-26	pg. 28442 53.20(d) Table B-1	25 26 12 29 2	Value signs (±) are incorrect for interference equivalent. The total interferent should be given as the absolute value.	Corrected in AIHL Sept.-Oct. 1973 Progress Report, Appendix I, page 3.
B-27	pg. 28442 53.20(d) Table B-1	29	The interferent values appear high, especially the total interferent.	We disagree. We think they are too tight for the present state of the art.
B-28	pg. 28442 53.20(d) Table B-1	7 2	Reduce zero drift to the range of 0.005 ppm to 0.01 ppm for SO_2 and O_3. A ± 0.02 ppm tolerance is 66% of the 0.03 ppm average annual standard for SO_2 and 25% of the 0.08 primary standard for O_3. In any case, drift should not exceed 15% of the standard.	Present specifications reflect the state of the art. Normally, it is the practice to subtract the drift values from ambient air readings and thus such drifts should not affect the annual readings.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-29	pg. 28442 53.20(d) Table B-1	2	24 hrs. is given for zero drift in the table, and 12 hrs. in the test.	See Appendix I, page 24, AIHL Sept.-Oct. 1973 Progress Report wherein the specifications were made to correspond to the tests.
B-30	pg. 28442 53.20(d) Table B-1	2	The 24 hr. drift value is more important than the 12 hr. value.	The 12 hr. test shows the continuous trace over 12 hr. whereas the 24 hr. data only indicates the instantaneous values at 24 hr. intervals.
B-31	pg. 28442 53.20(d) Table B-1	2	The specification should also list a value for 3-day zero drift.	We believe the 24-hour zero drift specification is adequate. In most monitoring operations, the instruments are rezeroed every 24 hours.
B-32	pg. 28442 53.20(d)	29	Zero drift specification is reasonable and somewhat tight.	We agree.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-33	pg. 28442 53.20(d) Table B-1	26	Zero drift value is OK.	We agree.
B-34	pg. 28442 53.20(d) Table B-1	27	As in Item 28, span drift should be also reduced from 0.005 to 0.001 for SO_2 and O_3.	See Item B-28.
B-35	pg. 28442 53.20(d) Table B-1	26 25 6 29	No time limit is given for the span drift.	Corrected in February 4, 1974 EPA draft.
B-36	pg. 28442 53.20(d) Table B-1	29	Span drift specification is reasonable.	We agree.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-37	pg. 28442 53.20(d) Table B-1	2	The specifications for lag, rise, and fall times are broad enough to cover wet chemical instruments and should not be applied to direct physical analyzers.	If we start dividing instruments into artificial classifications, we defeat the purpose of the regulations which is to establish reasonable minimum specification for all analyzers.
B-38	pg. 28442 53.20(d) Table B-1	29 26	The lag, rise, and fall times should be reduced to 3 minutes, and preferably 1 minute.	The current specifications are adequate for reporting one-hour averages for ambient air quality data.
B-39	pg. 28442 53.20(d)	12	Response times could be much shorter.	See Item B-38.
B-40	pg. 28442 53.20(d) Table B-1	28	Reduce lag time and rise time to 10 minutes each and the sum of both not to exceed 15	See Item B-38

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-40 (Con't.)		28	minutes. The present 15 minute tolerance for both can delay emergency alerts for up to 35 minutes.	
B-41	pg. 28442 53.20(d) Table B-1	25	The specifications for rise time, fall time, and lag time are too long and would result in excessive waits during alerts, the lag time should be 3 minutes, the fall time 5 minutes.	See Item B-38
B-42	pg. 28442 53.20(d) Table B-1	7	Specifications for precision appear too lax for the 20% range and too stringent for the 80% range for O_3 and SO_2	Revised in EPA draft, February 4, 1974.
B-43	pg. 28442 53.20(d) Table B-1	29 26	Specification for precision is reasonable and fairly tight.	We agree.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP- ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-44	pg. 28442 53.20(d) Table B-1	25	The precision specifications require a ± sign.	Corrected in Appendix I, page 3, AIHL Sept.-Oct. 1973 Progress Report.
B-45	pg. 28442 53.20(d) Table B-1	28	Unless the temperature of the ppm reading is within ± 2°C of 25°C, footnote "a" should read "to convert from ppm at pressure P torr and temperature T°C to $\mu g/M^3$ at 25°C, and 760 torr, multiply by (104.2)(M)(T+273.15)/p where M is the molecular weight of the gas".	In this conversion, ppm is considered to be at standard conditions of 25°C and 760 Torr.
B-46	pg. 28442 53.20(d) Table B-1	29 26	Specifications for NO, NO_2, and THC are missing. If there is a reason it should be so stated in the document.	See Item A-18.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-47	pg. 28442 53.20(d) Table B-1	25	Some of the tests can be run concurrently e.g. the noise test with zero drift.	See EPA draft February 4, 1974 and Appendix I, AIHL Sept.-Oct. 1973 Progress Report.
B-48	pg. 28442 53.20(d) Table B-1	20	These standards are invalid as they cannot be met even by the reference methods. (Respondent gives no proof or reasons)	One reference method that we have tested has passed all the specifications.
B-49	pg. 28442 53.20(d) Table B-1	12	Specifications are for the most part within the capabilities of existing instrumentation.	We agree.
B-50A	pg. 28442 53.20(d) Table B-1	19	Performance specifications in EPA publications of August 14, 1971 and November 25, 1971 do not agree with Table B-1. The former should be upgraded.	40 CFR 51, pg. 28438, ¶51.14 and ¶51.17 clearly state that the table of performance specificatio has been revised.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-50B	53.21 Test procedures for automated methods.	4	Add a test procedure for response to vibration.	This is not required under current regulations for air quality. Coul come under requirements in 53.4(f) and 53.5(e).
B-51	pg. 28442 53.21(a) Gas Generation	19 4	This paragraph requires "all diluent air shall be free from contamination". Since this is impossible, the maximum possible allowable concentration must be stated for each gas, within reasonable limitation.	Corrected in EPA draft, February 4, 1974.
B-52	pg. 28442 53.21(a) Gas Generation	19	"Output of the gas generation system shall be stable". How stable? How demonstrated?	See AIHL remark in 53.22(c) of EPA February 4, 1974 draft.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP- ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-53	pg. 28442 53.21(a) Gas Generation	26 29 2 4	The cylinder gases are supposedly certified by the manufacturer, but the details of the test analysis (e.g., precision and accuracy) are missing. Also, cylinders are sometimes 40% in error from supposed values. All gases should be verified.	We agree. The duplicate samples provision should also apply to all gases. Also see AIHL remarks in Table B-2 of EPA Feb. 4, 1974 draft.
B-54	pg. 28442 53.21(a) Gas Generation	19	"Concentration of test atmospheres shall be verified by duplicate samples...". Does this hold for gases which have been certified?	See 53.22(a), Gas Generation, in EPA February 4, 1974 draft.
B-55	pg. 28442 53.21(a) Gas Generation	27	The test atmosphere is assumed to be perfectly invariant. Since this cannot be so, the tolerance specifications must be corrected to allow for this.	See Item B-53 above.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-56	pg. 28442 53.21(a) Gas Generation	19	"Temp...around gas system shall be controlled to within ± 2°C". Does this mean ambient air in the test lab?	This requirement deleted in EPA February 4, 1974 draft.
B-57	pg. 28442 53.21(a) Gas Generation	25	The temp specification of ± 2°C is too restrictive and should be changed to 5°C.	See Item B-56 above.
B-58	pg. 28442 53.21(a) Gas Generation	21	Has commercially available permeation devices with a low temperature dependency of 2 to 3% per °C. Invites EPA to investigate these products.	The invitation should be accepted by EPA. The currently used permeation devices are critically temperature dependent.
B-59	pg. 28442 53.21(a) Gas Generation Line 12	11	Change "the temperature surrounding the gas generation system shall be controlled to within ± 2°C" to "the temperature of the gas surrounding	See Appendix I, page 4, AIHL Sept.-Oct. 1973 Progress Report as being a clearer explanation of the requirements. See also Item B-56.

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-59 (Con't.)		11	the gas generation system shall be within the operating range of the gas generation system and maintained within a variation of ± 2°C during the test period".	
B-60	pg. 28442 53.21(a) Gas Generation	11	Change to "if a permeation device is employed during the generation of the test atmosphere, the permeation device as well as the air passing over the device shall be maintained at a temperature which is within the normal operating temperature range of the device with a variation of less than ± 0.1°C of the selected temperature during the test period".	So stated in Appendix 1, page 4, AIHL Sept.-Oct. 1973 Progress Report. Also see EPA Feb. 4, 1974 draft.

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RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-61	pg. 28442 53.21(a) Gas Generation Line 18	11	Add "during", between "before" and "and" to provide for verification of the test atmosphere during the test.	Add "and/or during" between "before" and "and".
B-62	pg. 28442 53.21(a) Gas Generation	25	Use of stainless steel or TFE Teflon should be allowed for some of the gases.	We suggest that any inert material which has been demonstrated not to alter the test gas concentrations be allowed.
B-63	pg. 28442 53.21(a) Gas Generation Line 18	4	The reference to the design and construction of the gas generation system is vague and should be deleted.	See Appendix I, page 4 and page 29 AIHL Sept.-Oct. Progress Report wherein a more elaborate description is given.
B-64	pg. 28443 53.21(b)	2	Table B-2 requires certified gas in zero air for CO, CO_2, and CH_4	In most cases the interference equivalent is determined in the

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-64 (Con't.)	Table B-2	2	while the test procedure requires mixing the certified gas with zero air to achieve the test concentration. This is inconsistent.	presence of interferent and pollutant gases. The secondary mixing with zero air is a preliminary step in the test procedure for interference equivalent. The zero air is substituted with equal flow of pollutant test atmosphere later in the test.
B-65	pg. 28443 53.21(b) Table B-2	28	The requirements for the certification of the cylinder gases are inadequate. A standard could be obtained by the purchaser and comparison of 2 cylinders of the same gas from separate manufacturers, and/or an additional certification by an outside laboratory.	See EPA draft Feb. 4, 1974 and AIHL remarks thereon.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-66	pg. 28443 53.21(b) Table B-2	12	Cylinders should contain less than 700 ppm CO, since concentrations of around 2000 ppm are known to convert to iron pentacarbonyl.	See Table B-2 in EPA Feb. 4, 1974 draft.
B-67	pg. 28443 53.21(b) Table B-2	19	(For NO_2) "gas phase titration description available from NERC-RTP" should be included in document.	Reference added in EPA draft of Feb. 4, 1974.
B-68	pg. 28443 53.21(b) Table B-2	19	(For NO_2) "Permeation tube modified by NERC-RTP" should be included in document.	See Item B-67
B-69	pg. 28443 53.21(b) Table B-2	19	Footnote: Ref. 2 - 1970 annual book of ASTM standards should use current 1973 book.	Included in EPA Feb. 4, 1974 draft.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-70	pg. 28443 53.21(b) Table B-2	4	Water vapor test: Provide details of bubbler; some designs do not give saturated air. Also, the humidity measurement depends in part upon the technique used and this should be detailed.	Design of humidifier is the responsibility of the applicant.
B-71	pg. 28443 53.21(c)(2) Calibration of the instrument	4	Identify all 7 points with a tolerance for each point to allow more precise comparison of calibration curve.	Specified as "approximately equal spaced intervals" in EPA Feb. 4, 1974 draft. Comparison of curves may be done with slopes.
B-72	pg. 28443 53.21(c)(2) Calibration of the instrument	5 19	Must the calibration consist of 7 points when the output of the analyzer is known to be linear? This calls for more cylinders of	7 points are needed for greater statistical reliability.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-72 (Con't.)		19	gases or a more sophisticated dilution system. Would 5 be enough?	
B-73	pg. 28443 53.21(c)(2) Calibration of the instrument	19	"...dynamic calibration curve... including 0 and 90% of scale...". What is the meaning of dynamic?	Add definition o dynamic calibration in 53.20.
B-74	pg. 28443 53.21(c)(3) Safety	4	Spell out safety factors or make reference to applicable OSHA requirements.	These requirements should be considered and included in the sections for operational manual in 53.4 and 53.5.
B-75	pg. 28443 53.21(c)(3) Safety	19	"shall not...discharge any hazardous...effluent gas". Is the discharge of ethylene from	Both gases are hazardous. Discharges of analyzers should be properly vented as described by

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-75 (Con't.)		19	the chemiluminescent analyzers hazardous? Is the discharge from a CO analyzer hazardous?	the manufacturers.
B-76	pg. 28443 53.22(a) Range Line 9	4	Change example for range from 0 to 1.00 ppm to 0-0.5 ppm to correspond with one in Table B-1.	So changed in EPA Feb. 4, 1974 draft.
B-77	pg. 28443 53.22(a) Range Line 9	2	Procedures and specifications apply to operating on a single range only. Procedures should apply to other ranges also.	EPA Feb. 4, 1974 draft also covers multirange methods.
B-78	pg. 28443 53.22(a) Noise	25 19 5 1	Use of DVM precludes submission of recorder tracings.	So corrected in Appendix I pages 10 and 11 of AIHL Sept.-Oct. 1973 Progress Report and in EPA Feb. 4, 1974 draft.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-79	pg. 28443 53.22(a) Noise	25	The noise test cannot be carried out with a span gas as there are definite deviations in concentration, e.g., ± 0.004 ppm with SO_2 gas from a permeation system. We recommend deletion of the noise test at span.	We disagree. The noise at span is often substantially greater than at zero. See also Item B-52.
B-80a	pg. 28443 53.22(b) Noise	4	We find noise is better defined in terms of absolute range of chart rather than ppm.	a) Specifications are based on the ranges given in Table B-1 and apply to all ranges.
B-80b	(2)(vii) Noise		Certain noise frequency patterns may be missed by the random DVM readings.	b) We agree.
B-81	pg. 28443 53.22(b)(2)(vii) Noise	4 25	Errors in the noise equation: 1) The radical sign is missing from the standard deviation formula.	So corrected in Appendix I, pages 10 and 11, AIHL Sept.-Oct. 1973 Progress Report.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-81 (Con't.)		1	2) Small $\bar{k}$ becomes large $\bar{K}$, even though both are identical	
		11	3) $\underline{(d_i)}^2$ should be $(d_i)^2$	
B-82	pg. 28443 53.22(b)(2)(vii) Noise	25	"25 random readings taken during 60 minutes" does not agree with the definition of noise as short term, and may include zero drift in the result. Change to 25 readings taken within 2 minutes after a stable baseline is achieved.	The zero drift requirements make any significant drift during the noise test unlikely. Suggestion incorporated in EPA Feb. 4, 1974 draft.
B-83	pg. 28443 53.22(b)(2)(vii) Noise	19	Noise could easily result from exterior factors such as from outside electric mains, air sparks, etc. This should be ruled out.	Noise should apply to the analyzer performance and not reflect external factors.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-84	pg. 28443-44 53.22(c) Lower Detectable Limit	11	Add "as determined with zero air" after "noise level". The noise can be influenced by the magnitude of the detector signal.	Also corrected in EPA Feb. 4, 1974 draft.
B-85	pg. 28444 53.22(d) Interference Equivalent	5	Proposal indicates that some form of pre-scrubber will be required on our FPD analyzer for SO_2 to remove H_2S. Such contaminants do exist in our atmosphere and such scrubbers may degrade the pollutant of interest. The proposal should allow more flexibility and judgment.	Paragraph 53.22(d)(2)(ii) does not require the use of any pre-scrubers.
B-86	pg. 28444 53.22(d)	26 29	No method of flow measurement and control is stated. The only re-	The procedure and specifications in the EPA Feb. 4, 1974 draft

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-86 (Con't.)				
	Interference Equivalent	19	striction is that the interferent concentration be within ± 20% of the stated value. This permits cancelling the effect of any interferent by flow adjustment. Also, no flow reading is required.	requires the test gas concentrations be prepared and controlled to ± 10%. We recommend preparation and control of test gas concentrations to ± 5% of stated values.
B-87	pg. 28444 53.22(d) Interference Equivalent	4	Test provides no provision for synergistic effects. For example, in electrochemical SO_2 analyzers, NO_2 together with water gives a larger response than the response separately.	This is beyond the capabilities of the test.
B-88	pg. 28444 53.22(d) Interference Equivalent	25	How can "x" be diluted and still have same concentration as specified?	Corrected in Appendix I, p. 14, AIHL Sept.-Oct. 1973 Progress Report.

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-89	pg. 28444 53.22(d) Interference Equivalent.	25 1	The gas concentrations must have a clear cut value reference to Table B-3. The words "specified concentrations" are used for x, y, and z, and then for x + y, x + z. They are contradictory.	Corrected in Appendix I, p. 1, AIHL Sept.-Oct. 1973 Progress Report.
B-90	-2(b)(iii)-(iv)	1	Composition of test gas is indeterminate. Procedure is inconsistent with the procedural description of gases x + y.	See Item B-89 above.
B-91	-2(b)(iii)-(iv)	25	It is unreasonable to use the sum of the absolute values of the individual interferences as some gases compensate for each other. A formula should be prepared to take this into account.	This is beyond the scope of the test required.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-92	-2(iv)(c)-line 2	11	Change "z" to "y"	Corrected in Appendix 1, AIHL Sept.-Oct. 1973 Progress Report.
B-93	-2(xiii)	11	Change to: "make a reading; subtract from this the reading obtained from zero gas. Record the difference as the "interference equivalent absolute concentration limit" to account for zero effect.	Same as Item B-92 above.
B-94	pg. 28444 53.22(d) Interference Equivalent	19	Procedure appears over complicated and tedious.	The information needed requires a definitive procedure that cannot be easily made simple.
B-95	pg. 28444 53.22(d)(2)(e)	25 26	Specifications for NO_2 and THC are included in Table B-3 even	Editorial error-corrected in EPA draft of Feb. 4, 1974.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-95 (Con't.)		29	though not discussed elsewhere.	
		19	A reason should be so stated.	
B-96	pg. 28444 53.22(d)(2)(e)	5	Are interferent levels listed realistic? For example 750 ppm CO_2 is about twice the level in ambient air. How about possible quenching effect of CO_2 in chemiluminescent analyzers for O_3?	The concentrations listed are compromises reflecting experiences under a wide variety of monitoring situations and practical test limitations.
B-97	pg. 28444 53.22(d)(2)(3)	25	Conc. of H_2S is unrealistic by 100X of amount in ambient air.	See Item 96 above.
B-98	pg. 28444 53.22(d)(2)(e)	25	The Table does not list all possible methods, e.g., coloumetric and polarographic for SO_2.	See Item 99 below.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-99	pg. 28444 53.22(d)(2)(e)	15	Table B-3 should have only the status of a guide, unless EPA believes there are no other possible methods or interferences.	Table B-3 in EPA draft of Feb. 4, 1974 allows for future consideration of other measurement principles.
B-100	pg. 28445 53.22(f)(4) Test Procedure for zero and span drift	11	Instructions are confusing. Allow too much interpretation; may be incomplete, and require back and forth referencing from the text to Table B-4. Expand Table B-4 to indicate timing of all measurements; including zero, span 1, span 2, lag time, rise time and fall time.	A refined plan is given in Appendix 1, p. 19 AIHL Sept.-Oct. 1973 Progress Report. Test instructions are clarified in same report.

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-101	pg. 28445 53.22(f)(4) Test Procedure for zero and span drift	26	Since calibration is permitted every 72 hours in Subpart C consistency tests, then it should also be permitted in zero and span drift tests in Subpart B.	In the EPA draft of Feb. 4, 1974 the provision in Subpart C permitting calibration every 72 hrs. has been deleted.
B-102	53.22(f)(4)(vi)	19	"Test concentration shall be consistent from day to day". How accomplished? Drift in day to day test gas concentration will obscure analyzer drift.	See Item B-52 above.
B-103	53.22(f)(5)(i) Lag Time	4	Definition is not adequate for instruments using GC for separation of individual components.	We agree that the performance specifications in this procedure may not always be applicable to GC type analyzers

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-104	pg. 28445 53.22(f)(5) Lag Time	19	What is the instrument inlet? What is first observable change in output?	1) The sampling port so designated by the manufacturer. 2) The change equal to 2X noise as recommended in AIHL Sept.-Oct. 1973 Progress Report.
B-105	53.22(f)(6)	19	It is impossible to know when the response equals 5% of upper range limit, since this value is not known beforehand.	It's possible.
			Propose another method for response times similar to the international standard method for electronic instruments.	No comment
B-106	53.22(f)(6) 53.22(f)(8)(g) 53.22(f)(8)(m)	27	An example of each calculation needed in this section would be helpful.	Equations and data sheets added In EPA draft of Feb. 4, 1974.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESPONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
-107	pg. 28445 53.22(f)(7)(ii)(b)	11	Change to "sample zero air and use a stopwatch to time the interval starting with the first observable instrument output response due to the concentration step change and ending when the response reaches 95% of the way to the zero reading obtained in 53.22(f)(6), rise time, and corrected for zero base line drift used on said zero reading".	We believe the procedure is clear enough.
B-108	pg. 28445 53.22(f)(7)(ii)(b) Fall Time	11	Change "Repeat steps (a),(b), and (c), to repeat rise time and fall time tests".	See Appendix I, pp 22 to 24, AIHL Sept.-Oct. 1973 Progress Report wherein work definitive test procedure are recommended.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-109	pg. 28445 53.22(f)(8) Precision	25	These sections do not stipulate at what time you record the value after "switching quickly to pollutant concentration used". We recommend 1 hour.	Corrected in Appendix I, p. 24, AIHL Sept.-Oct., 1973 Progress Report.
			No time period is given after sampling the higher concentration. It should read "after stable output is obtained.	See Item B-109 above.
B-110	f(8)(ii)(g) & (8)(ii)(i)	19 25	"Calculate and report the mean and standard deviation for these 6 values" is incorrect. Should be calculated for each group of 3 data.	See Item B-109 above, p. 25 and 26.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-111	f(8)(ii)(k)	1	Procedure should read "switch to (i)" not to (j).	See Item B-109 above, p. 25.
B-112	pg. 28446 53.22(g) Table B-4	1	Point out in text that the two values for line voltage and for temp. constitute specifications for voltage and temperature.	This seems to be a valid criticism.
B-113	pg. 28446 53.22(g) Table B-4	1	Temperature and voltage settings for night tests appear to be missing.	Clarified in Appendix I, p. 27, AIHL Sept.-Oct. 1973 Progress Report.
B-114	pg. 28446 Table B-4	29	Good test plan	We agree. However, it needs to improved. See suggested version in the AIHL Sept.-Oct. 1973 Progress Report.

RESPONSES TO SUBPART B

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
B-115	Table B-1, B-2 and B-3	29	Specifications given for O_3, SO_2, and CO only. NO_2 and THC should be included.	The proposed regulations currently do not include NO_2 and THC; therefore no specifications for these methods should be included for now.

REVIEW OF RESPONDENTS' COMMENTS AND RECOMMENDATIONS ON SUBPART C

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RESPONSES TO SUBPART C

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
C-1	pg. 28446, 53.30/ overall proposal	19	The procedure appears over-complicated and tedious and should be simplified.	The procedures have been simplified - see recommended draft of Subpart C in Appendix II, AIHL Sept.-Oct., 1973 Progress Report.
C-2	53.30-53.33	28	Differences in analyzer hourly average readings in excess of tolerance due to differences in the lag and response times of the reference and candidate methods should not be cause for rejection.	Test procedure should allow compensation for differences in response time characteristics between reference and candidate methods. Has been corrected in EPA draft of Feb. 4, 1974.
C-3	53.30(a)	27	There is no justification for requiring that the test sampling site be located in areas of maximum expectant pollutant concentrations	Other substances are generally associated with high pollutant concentrations in smoggy air. This requirement is an attempt

RESPONSES TO SUBPART C

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
C-3 (Con't.)		27	since the concentrations are to be altered by spiking anyway.	to obtain test atmosphere compositions that are as close to realistic as practical.
			Also, does this mean the tests should be conducted during periods of maximum pollutant concentration and that this period might be different for each pollutant?	No provision is given whether the testing shall be conducted during seasons when maximum pollutant levels are expected. More clarification is needed here.
C-4	pg. 28446, 53.30(a)	6	Requirements for test site are insufficient. For instance, CO concentrations adjacent to a traffic intersection may be much higher than elsewhere. Then distance from curb and sampling site must be known.	This specification applies to sampling community air. See also Item C-5.

RESPONSES TO SUBPART C

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
C-5		25	Object to "the Administrator retains the discretion to select sampling sites for the tests he determines necessary to conduct" as being costly to some manufacturers and favoring some companies due to geographic location.	Revision of test site requirements should be considered by EPA.
C-6	53.30(b)	12	Performance efficiency of the ozone generator is not mentioned.	Not relevant since reference and candidate analyzers are already calibrated.
			Reliance on manufacturer for standard gases is unreliable and methods for verification should be included.	See remarks in B-65.
C-7	53.30(b)	25	The stipulation that "the intake...manifold shall be designed	Corrected in EPA draft of Feb. 4, 1974.

RESPONSES TO SUBPART C

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
C-7 (Con't.)		25	so as not to remove particles or trace gases" is impossible. Change to "reasonable precautions shall be taken to minimize the removal of particles and trace gases".	
C-8	53.30(c)	25	Requirements are expensive and time-consuming. EPA should conduct these tests.	No comment
C-9	53.30(e)	25	It is illogical to require any method bear a "constant relationship" to a reference method since the reference may have more drift, interferences and less accuracy. The candidate method may have a much smaller absolute error and still be	Tolerances in the test procedures should be sufficient to accommmodat such differences.

ITEM	SECTION/LINE-TOPIC	RESP- ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
C-9 (Con't.)		25	rejected unless the method drifts in the same direction and suffers the same interferences as the reference. This section requires that the manufacturer provide methods "as bad as" the reference instead of the best available.	
			The procedures should require meeting Subpart B and submission of a correlation plot relating the reference and candidate method readings which are based on the same conditions specified in Subpart C.	
C-10	pg. 28446; 53.31 (a)(3); 53.32(a)	29	Calibrations are permitted once every 72 hrs. If required for	See Item B-101.

RESPONSES TO SUBPART C

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
	(b); 53.33(a)(1)(iii)		Subpart C it should also be in tests for zero and span drifts in Subpart B.	
C-11	53.31(b)	1	Paragraph states "Description of the methods used to obtain the hourly averages shall be submitted". Will manual integration of the chart traces described in 53.32(b)(1) be accepted?	Yes
C-12	pg. 28446; 53.31(b)(1)	1	Change 1.1 ppm to 0.10 ppm to correspond to Table C-1.	Corrected in Appendix III, AIHL Sept.-Oct. 1973 Progress Report.
C-13	53.31(b)(1)		Value for oxidant is based on 1-hour averages only while the procedure for CO and SO_2 permits	Same remark as in Item C-12.

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
C-13 (Con't.)			averaging 12 equally spaced readings over a 1 hr. period. This option should also apply to the oxidant procedure.	
C-14	53.31(c)/Tables C-1, C-3	29	Tolerances are tight and should assure accurate instruments.	No comments.
C-15	53.31(c)/Tables C-2	29	Good sampling plans.	We believe them to be acceptable.
C-16	53.32(b)	6	Range of 35 to 45 ppm CO is insufficient. Change 55 to 75 ppm.	Administrator has the discretion to permit changes in range.
C-17	53.32(b)	1	The 5-channel Beckman 6800 cannot meet 12 samples/hour.	See Item B-103.

RESPONSES TO SUBPART C

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
C-18	pg. 28447 53.33 Test Procedure, SO_2	25	Concentrations at low, medium, and high, cannot be maintained due to variability of ambient air.	Concentration levels are maintained artificially by adding pollutant and/or zero air.
C-19	pg. 28447 53.33 Consistency Test Procedure, SO_2	25	Use of West-Gaeke method for SO_2 is not recommended, since the precision is only 4.5% at 95% confidence level. Use of NBS permeation tubes allows greater accuracy.	Corrected in EPA draft of Feb. 4, 1974.
C-20	pg. 28447 53.33(a) SO_2 Manual Methods	5	Control samples, cannot be introduced or operational checks be made during an operational period, and at the same time obtain the hourly sampling averages required by the procedure.	Clarified in EPA draft of Feb. 4, 1974.

RESPONSES TO SUBPART C

ITEM	SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
C-21	pg. 28448 53.33(b)	4	Section has two "b" paragraphs: (b) Test specifications for SO_2; (b) Table C-3. (c) Correct the section designation of Table C-3 to (c).	Corrected in Appendix II, AIHL Sept.-Oct. 1973 Progress Report
C-22	pg. 28448 53.33(b) Table C-3	7	Reduce the SO_2 tolerance to the range of 0.005 to .01 ppm, because a ± .02 ppm tolerance constitutes 66% of the .03 ppm annual average for SO_2.	No comment.
C-23	53.33(d)(3) Line 10.	2	This sentence refers to a "very high" concentration instead of the "high concentratration" referred to in Table C-3 or C-4.	Corrected in EPA draft of Feb. 4, 1974, and Appendix II, AIHL Sept.-Oct. 1973 Progress Report.
C-24	pg. 28448 5.33(d)(3)	2,4	This paragraph refers to 24 and 3 hr. samples and cites tables	Corrected in EPA draft of Feb. 4 1974 and in Appendix II, AIHL

RESPONSES TO SUBPART C

SECTION/LINE-TOPIC	RESP-ONDENT	RESPONDENT'S COMMENTS	AIHL REMARKS OR RECOMMENDATIONS
C-24 (Cont'.)	2,4	C-3 and C-4. Line 14 makes reference to 3 hr. values, but Table C-3 contains only 24 and 1 hr. values. Inconsistent; needs correction.	Sept.-Oct. 1973 Progress Report.
C-25 53.33(d)(3) Line 5	4	Sentence refers to 4 sampling ranges while Tables C-3 and C-4 cite only 3 ranges.	Same as remark in C-24 above.